Appendix K

DRAINAGE STUDY

CEQA PRELIMINARY HYDROLOGY/ DRAINAGE STUDY
California Crossings, TM 21046

County of San Diego, CA
November 2009

Prepared For:

Otay Mesa Crossing, LLC
c/o Erwin Bucy
Regency Centers
915 Wilshire Boulevard, Suite 2200
Los Angeles, CA 90017

Prepared By:

PROJECT DESIGN CONSULTANTS
Planning | Landscape Architecture | Environmental | Engineering | Survey

701 B Street, Suite 800
San Diego, CA 92101
619.235.6471 Tel
619.234.0349 Fax

PDC Job No. 3315.00

Prepared by: C. Pack, P.E.
Under the supervision of

Debby Reece, PE RCE 56148
Registration Expires 12/31/10

TABLE OF CONTENTS

FIGURES

TABLES

APPENDICES

1. INTRODUCTION

This drainage report has been prepared in support of a Tentative Parcel Map and Major Use Permit submittal for the California Crossings project, which is located in the County of San Diego, California. The purpose of this report is to determine the hydrologic impact, if any, to the existing storm drain facilities or natural drainage, and to provide peak 100-year discharge values for existing and proposed conditions.

The drainage analyses presented herein reflect a Tentative Parcel Map and Major Use Permit level-of-effort, which include peak 100-year storm event hydrologic analyses using preliminary grades. Hydraulic analyses for detention, inlets, pipe inverts and HGL's will be provided during final engineering. *Therefore, the purpose of this report submittal is to acquire from the County: 1) concept approval of the proposed storm drain layout, 2) approval of the methodology used in the evaluation of the Project storm drain system hydrology, and 3) identification of critical path drainage issues that need to be addressed during final engineering.*

This project has a gross acreage of 29.6 acres, and is located North of Highway 905 (Otay Mesa Road) and West of Harvest Road and East of State Route 125. The project involves the construction of a retail commercial center and associated parking lots. See Figure 1 for the project vicinity map.

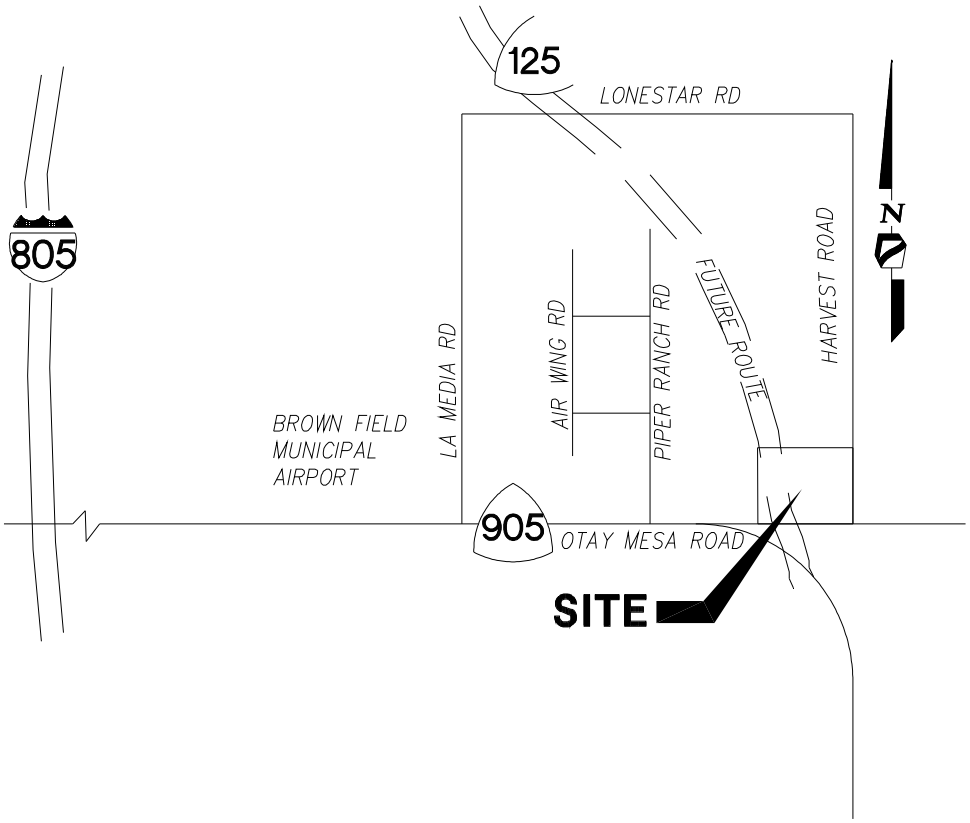


Figure 1: Project Vicinity Map

2. EXISTING AND PROPOSED DRAINAGE PATTERNS AND IMPROVEMENTS

Under existing conditions, the project area currently consists of flat terrain sloping in the south westerly direction, with natural ground cover. Some offsite area along the North and East sides of the project contribute runon to the site, particularly because the current condition of Harvest Road is not improved and therefore does not function as a drainage divide. Drainage along the

west side of the project is collected in a concrete ditch and directed to the south. A precast double 6'x2' (1.8x0.6m) RCB recently built per the Caltrans plans collects the runoff in the southwest corner of the site and conveys it to the south underneath Otay Mesa Road. A very small portion of the northwest corner of the site drains to the north in the ditch built per the Caltrans plans.

Under proposed conditions, the project grading will be designed to drain to the southwest corner of the site to match existing conditions. The site will provide onsite detention to ensure that runoff resulting from the developed condition is equal to or less than the runoff from the existing condition in order to discharge into the existing double 6'x2' (1.8x0.6m) RCB. In the proposed condition, the offsite runoff east of Harvest Road will be collected by a storm drain extension in Otay Mesa Road so that the offsite water will still drain to the existing culvert.

3. HYDROLOGIC CRITERIA, METHODOLOGY, AND RESULTS

This section of the report summarizes the drainage criteria that were used in the hydrologic analysis and key elements of the methodology.

3.1 Hydrology Criteria

The drainage basins were delineated using available topography and the preliminary proposed grading layout for the project. Table 1 summarizes the key hydrology assumptions and criteria used for the hydrologic modeling.

Table 1: Hydrology Criteria

Hydrology:	100-year storm frequency
Flood Control Detention:	100-year, 6-hour storm event
Soil Type:	Hydrologic Soil Group D
Land Use / Runoff Coefficients:	Based on criteria presented in the 2003 County of San Diego Hydrology Manual.
Rainfall intensity:	Based on intensity duration frequency relationships presented in the 2003 County of San Diego Hydrology Manual.

3.2 Hydrologic Methodology

Hydrology calculations were completed only for proposed conditions as site runoff is conveyed to the existing backbone system. The existing condition for the site was analyzed previously by Caltrans for the adjacent State Route 125 improvements. Excerpts from the *Addendum to the Drainage Report for SR-125 South Toll Road Segment 1A* and the Drainage Plans are provided in Appendix 2 for reference. The drainage addendum was written by Rick Engineering for Caltrans. Caltrans designed the precast double 6'x2' (1.8x0.6m) RCB to convey the existing condition 100-year peak flow from the site and adjacent runon areas.

For the proposed condition hydrology, the drainage areas were defined according to the preliminary grading concept for the site. Precise grading of the site during final engineering may alter the tributary drainage areas to the individual grass swales, but will not drastically alter the drainage plan for the site.

The area to the East and North of the project is planned for development by others, but it is unknown at this time how the other developer will connect into the backbone system. Therefore, the drainage calculations for this project are based on the existing condition for the offsite runon areas.

3.3 Description of Hydrologic Modeling Software

The Modified Rational Method was used to determine the 100-year storm flow for the design of the storm system. The Civil-D Rational Method Program was used to perform the hydrologic calculations. This section provides a brief explanation of the computational procedure used in the computer model.

The Civil-D Modified Rational Method Hydrology Program is a computer-aided design program where the user develops a node link model of the watershed. Developing independent node link models for each interior watershed and linking these sub-models together at confluence points creates the node link model. The intensity-duration-frequency relationships are applied to each of the drainage areas in the model to get the peak flow rates at each point of interest.

4. HYDROLOGY ANALYSIS RESULTS

For results of the analysis see Exhibit A for the proposed conditions hydrology map, and Appendices 2 and 3 for existing and proposed conditions hydrology calculations.

The project site's overall proposed drainage basin is the same as the existing conditions. Any increase in storm water runoff generated by the development will be attenuated by a proposed underground detention basin. The hydrology results for the existing and proposed conditions are summarized below.

Table 2: Hydrology Results

	"BACKBONE" (Q ALLOWABLE) EXISTING CONDITIONS PER CALTRANS REPORT			**PROPOSED CONDITIONS**			
Point of Interest (Description)	***Description***	***Q100 (cfs)***	***Contrib. Area (acres)***	***System***	***Node***	***Q100 (cfs)***	***Contrib. Area (acres)***
Backbone storm drain, double 6'x2' (1.8x0.6m) RCB near Otay Mesa Road	(From "TA1-Watershed A - Summary of Peak Discharge" table in Caltrans Report)	95.3	60.33	System 100	180	Qin=80.7 (undetained), Qout<=25.3 (detained)	19.89
				System 200	285	70.0	40.81
Total at outfall=		**95.3**	**60.33**			**<=95.3**	**60.70**

4.1 Detention Volume Estimates

The results in Table 2 are dependent on sufficient detention volumes to attenuate the proposed peak flows so that the results are less than or equal to pre-development peak flow rates. The detention basin routing and design of the outlet structures will be performed during final engineering. However, detention volume estimates are needed at this preliminary stage to verify the project has sufficient detention volume. For this reason, Haestad Method's PondPack

software was used to determine the detention volume required to attenuate the peak flow down to the required rate. Refer to Appendix 4 for the calculations.

For all of the area draining into the detention basin (System 100), the peak inflow hydrograph was generated with Rick Engineering Rational Method Hydrograph Generator. This program develops a synthetic hydrograph per the 2003 County Hydrology Manual by using the results of the CivilD output. The inflow hydrograph was then input into PondPack and the curvilinear estimate was used to determine the volume required to attenuate the flow down to the target rate. The target rate is the difference between the backbone peak flow rate and the peak flow rate from System 200 (which represents all of the area that will not drain into the detention basin.) Table 3 summarizes the detention volumes required and detention volumes provided per the tentative parcel map.

Table 3: Detention Basin Summary

Location of Detention Basin	Drainage System	Detention Volume Required	Volume Provided	Notes:
Underground Storage	System 100	1.0 AF	1.2 AF	Assume 5' deep of water storage

4.2 Detention Basin Maintenance Summary

The maintenance of the private underground detention basin facility will be the responsibility of the Property Management Association for the California Crossings project. The detention facility will be designed during final engineering. The provision for maintenance will include a combination of manhole(s) and strategically located inspection port(s) to observe the condition of the facility from the surface. The level of sediment and debris should be inspected at least twice a year. If upon visual inspection, it is found that the outlet is clogged or that sediment or debris has accumulated up to a certain pre-determined depth (i.e., 3 inches), a clean-out should be performed with a vacuum truck, JetVac process, or equally effective method.

5. ENVIRONMENTAL IMPACTS

This section summarizes the following questions for CEQA purposes.

Would the project:

1. **Substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river, in a manner which would result in substantial erosion or siltation on- or off-site?**

   The project's drainage patterns mimic the existing conditions, so no substantial impacts will exist.

2. **Substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river, or substantially increase the rate or amount of surface runoff in a manner which would result in flooding on- or off-site?**

   A flood-control underground detention basin will be provided to ensure that peak flow rates under proposed conditions are not greater than existing peak flow rates.

3. **Create or contribute runoff water which would exceed the capacity of existing or planned storm water drainage systems?**

   The recently constructed Caltrans culvert crossing underneath Otay Mesa Road was sized for the existing flow rate. Since the detention basin will attenuate back to the Caltrans flow rate for existing conditions, the capacity will not be exceeded.

4. **Place housing within a 100-year flood hazard area as mapped on a federal Flood Hazard Boundary or Flood Insurance Rate Map or other flood hazard delineation map, including County Floodplain Maps? For example; research the foregoing and provide same (to indicate applicability or not) in the study.**

   There is no housing proposed for this site. In any case, there are no 100-year flood hazard zones within the project site. See a copy of the FIRM panel in Appendix 1.

5. **Place within a 100-year flood hazard area structures which would impede or redirect flood flows?**

   See response to Question 4.

6. **Expose people or structures to a significant risk of loss, injury or death involving flooding, including flooding as a result of the failure of a levee or dam on-site or off site?**

   There are no dams or levees within or near the project site.

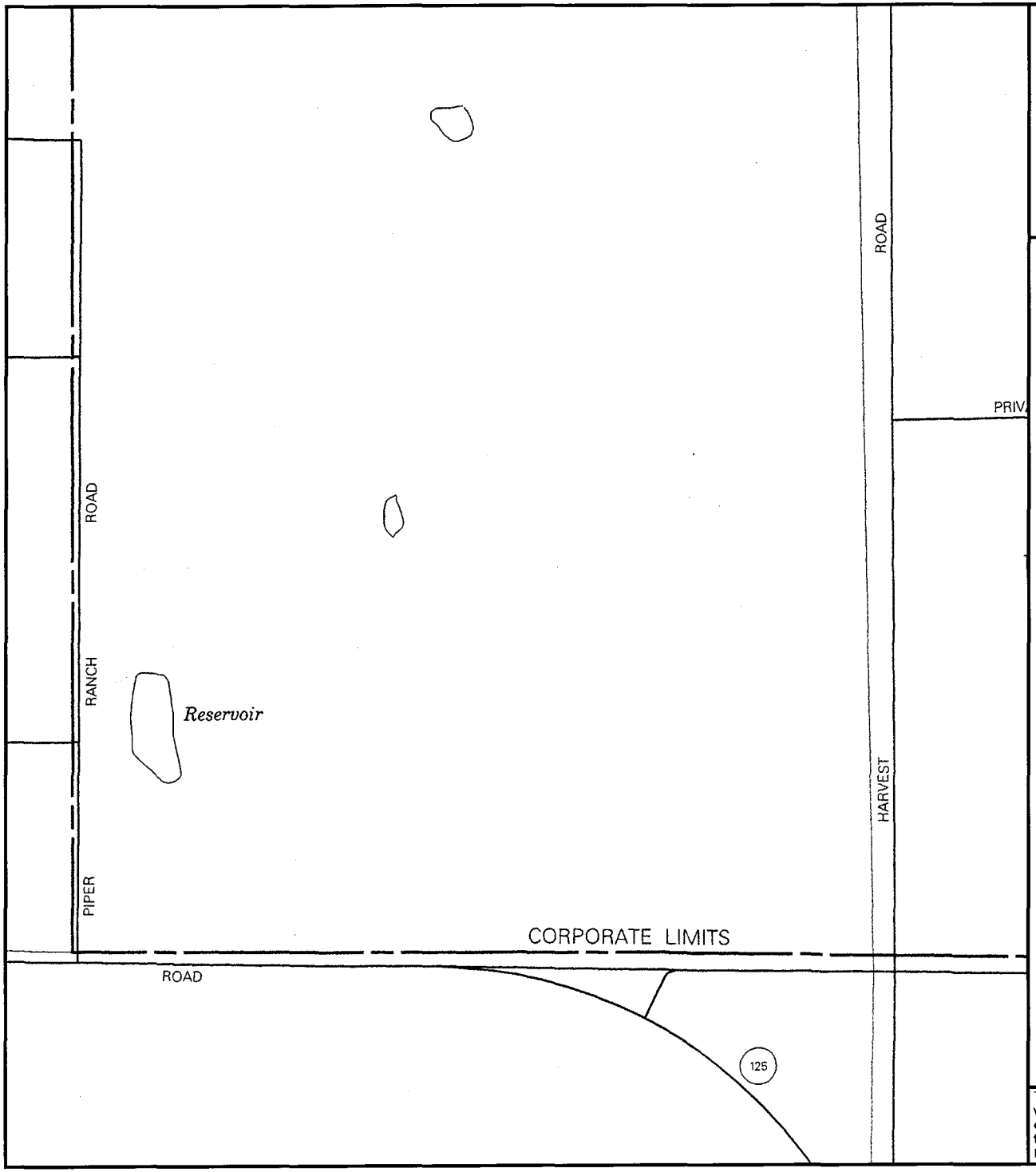
6. CONCLUSION

This drainage report has been prepared in support of the preliminary design of the storm drain improvements for the tentative parcel map for the California Crossings project. The purpose of this report is to provide peak discharges for use in designing the private storm drain system for the project and to verify that the detention volume provided is adequate to detain the post-project flows to the pre-project flows. The hydrology results indicate that the peak flow from the developed site will be less than the existing flows with the detention basin provided. Therefore, the storm drain system will be sufficient to satisfy County criteria in the post-development condition. A Storm Water Management Plan, submitted separately, describes proposed water quality alternatives to meet BMP requirements.

APPENDIX 1

Supporting Documentation

(Isopluvial Maps, Runoff Coefficients, etc.)



APPROXIMATE SCALE IN FEET

500 0 500

NATIONAL FLOOD INSURANCE PROGRAM

FIRM

FLOOD INSURANCE RATE MAP

SAN DIEGO COUNTY, CALIFORNIA AND INCORPORATED AREAS

PANEL 2179 OF 2375

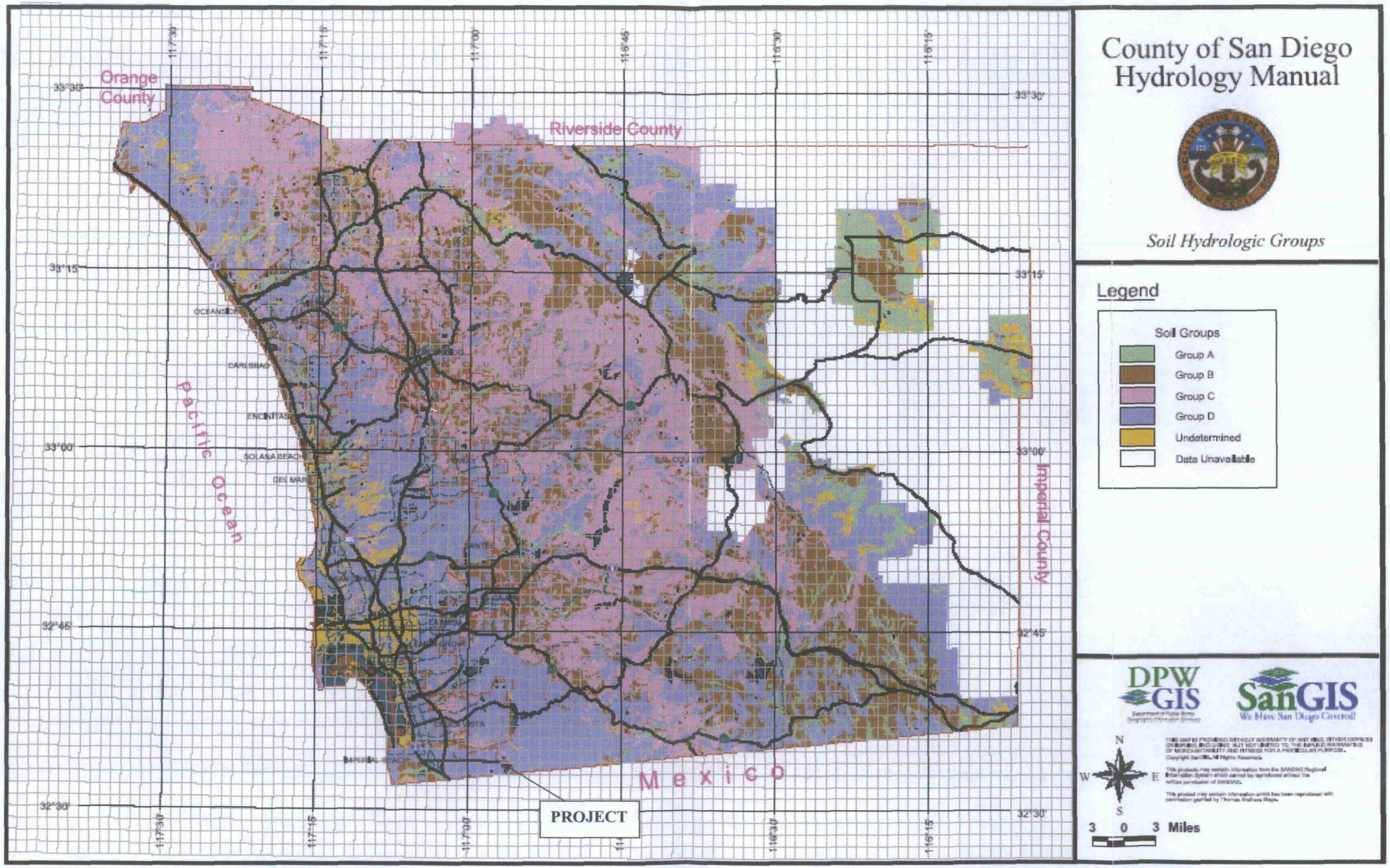
(SEE MAP INDEX FOR PANELS NOT PRINTED)

CONTAINS: COMMUNITY	NUMBER	PANEL	SUFFIX
SAN DIEGO COUNTY, UNINCORPORATED AREAS	060284	2179	F
SAN DIEGO, CITY OF	060295	2179	F

MAP NUMBER 06073C2179 F

EFFECTIVE DATE: JUNE 19, 1997

Federal Emergency Management Agency


Orange County
Riverside County
Pacific Ocean
Imperial County
Mexico
PROJECT
117°30'
117°15'
117°00'
116°45'
116°30'
116°15'
33°30'
33°15'
33°00'
32°45'
32°30'
OCEANSIDE
CARLSBAD
ENCINITAS
SOLANA BEACH
DEL MAR
SAN DIEGO
BONITA
NATIONAL CITY
County of San Diego
Hydrology Manual
Soil Hydrologic Groups
Legend
Soil Groups
Group A
Group B
Group C
Group D
Undetermined
Data Unavailable
DPW GIS
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3 0 3 Miles

Table 3-1
RUNOFF COEFFICIENTS FOR URBAN AREAS

Land Use		Runoff Coefficient "C"				
			Soil Type			
NRCS Elements	County Elements	% IMPER.	A	B	C	D
Undisturbed Natural Terrain (Natural)	Permanent Open Space	0*	0.20	0.25	0.30	0.35
Low Density Residential (LDR)	Residential, 1.0 DU/A or less	10	0.27	0.32	0.36	0.41
Low Density Residential (LDR)	Residential, 2.0 DU/A or less	20	0.34	0.38	0.42	0.46
Low Density Residential (LDR)	Residential, 2.9 DU/A or less	25	0.38	0.41	0.45	0.49
Medium Density Residential (MDR)	Residential, 4.3 DU/A or less	30	0.41	0.45	0.48	0.52
Medium Density Residential (MDR)	Residential, 7.3 DU/A or less	40	0.48	0.51	0.54	0.57
Medium Density Residential (MDR)	Residential, 10.9 DU/A or less	45	0.52	0.54	0.57	0.60
Medium Density Residential (MDR)	Residential, 14.5 DU/A or less	50	0.55	0.58	0.60	0.63
High Density Residential (HDR)	Residential, 24.0 DU/A or less	65	0.66	0.67	0.69	0.71
High Density Residential (HDR)	Residential, 43.0 DU/A or less	80	0.76	0.77	0.78	0.79
Commercial/Industrial (N. Com)	Neighborhood Commercial	80	0.76	0.77	0.78	0.79
Commercial/Industrial (G. Com)	General Commercial	85	0.80	0.80	0.81	0.82
Commercial/Industrial (O.P. Com)	Office Professional/Commercial	90	0.83	0.84	0.84	0.85
Commercial/Industrial (Limited I.)	Limited Industrial	90	0.83	0.84	0.84	0.85
Commercial/Industrial (General I.)	General Industrial	95	0.87	0.87	0.87	0.87

*The values associated with 0% impervious may be used for direct calculation of the runoff coefficient as described in Section 3.1.2 (representing the pervious runoff coefficient, Cp, for the soil type), or for areas that will remain undisturbed in perpetuity. Justification must be given that the area will remain natural forever (e.g., the area is located in Cleveland National Forest).
DU/A = dwelling units per acre
NRCS = National Resources Conservation Service

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Low Density Residential (LDR)	Residential, 2.9 DU/A or less	25	0.38	0.41	0.45	0.49
Medium Density Residential (MDR)	Residential, 4.3 DU/A or less	30	0.41	0.45	0.48	0.52
Medium Density Residential (MDR)	Residential, 7.3 DU/A or less	40	0.48	0.51	0.54	0.57
Medium Density Residential (MDR)	Residential, 10.9 DU/A or less	45	0.52	0.54	0.57	0.60
Medium Density Residential (MDR)	Residential, 14.5 DU/A or less	50	0.55	0.58	0.60	0.63
High Density Residential (HDR)	Residential, 24.0 DU/A or less	65	0.66	0.67	0.69	0.71
High Density Residential (HDR)	Residential, 43.0 DU/A or less	80	0.76	0.77	0.78	0.79
Commercial/Industrial (N. Com)	Neighborhood Commercial	80	0.76	0.77	0.78	0.79
Commercial/Industrial (G. Com)	General Commercial	85	0.80	0.80	0.81	0.82
Commercial/Industrial (O.P. Com)	Office Professional/Commercial	90	0.83	0.84	0.84	0.85
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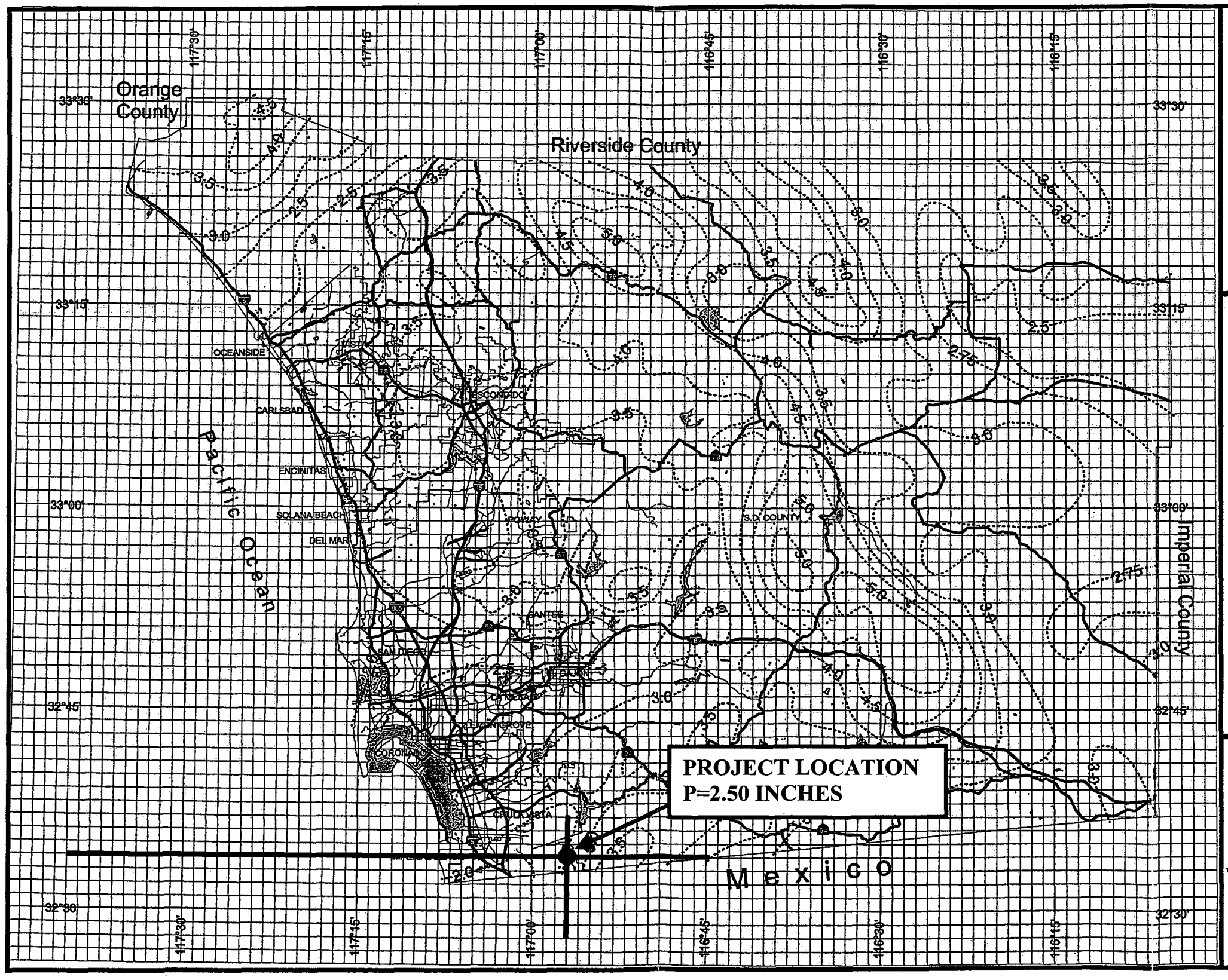
DU/A = dwelling units per acre
NRCS = National Resources Conservation Service

County of San Diego Hydrology Manual

Rainfall Isopluvials

100 Year Rainfall Event - 6 Hours

Isopluvial (inches)



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Department of Public Works
Geographic Information Services

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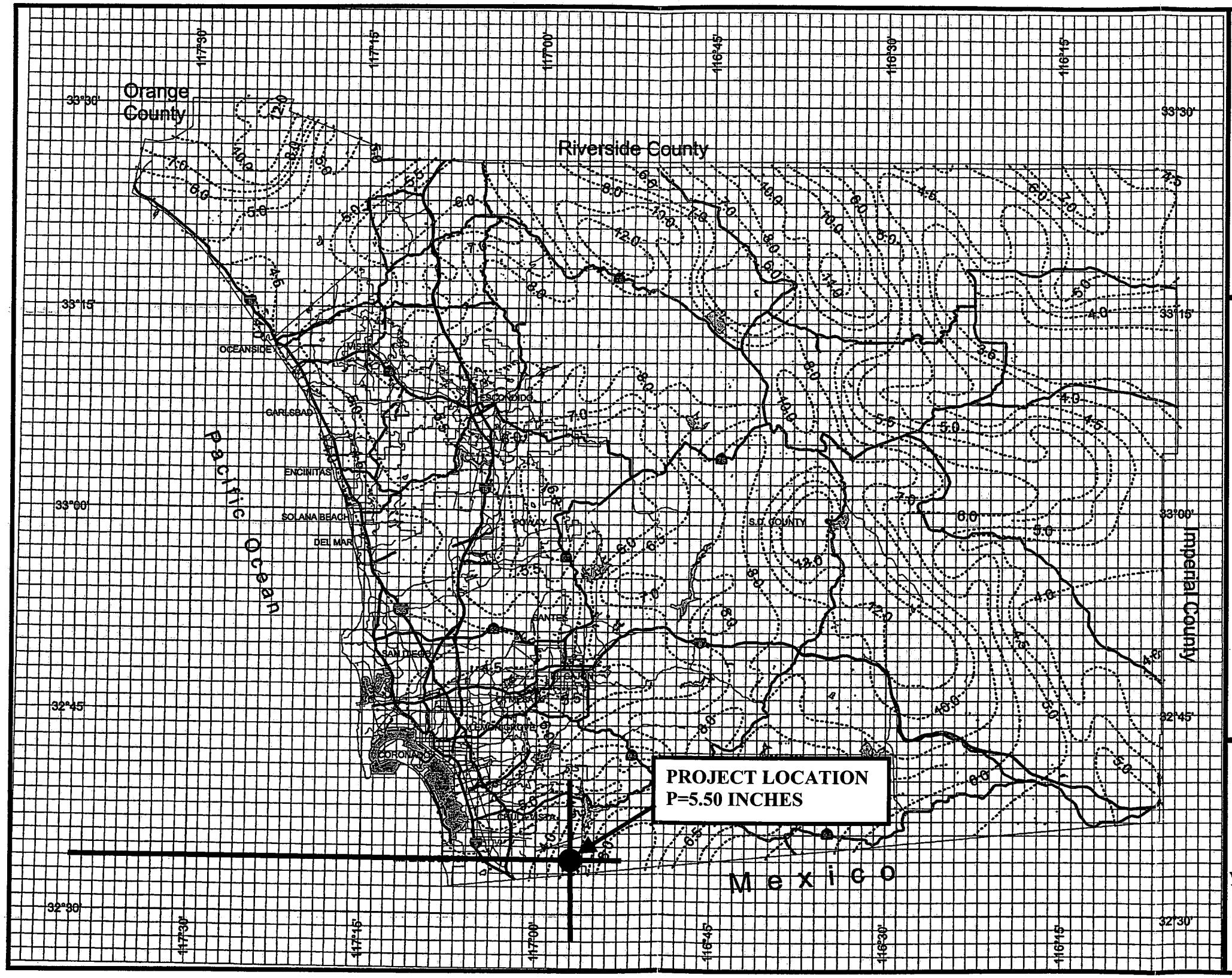
N W E S

3 0 3 Miles

County of San Diego Hydrology Manual

Rainfall Isopluvials



100 Year Rainfall Event - 24 Hours

Isopluvial (inches)

DPW GIS
Department of Public Works Geographic Information Services

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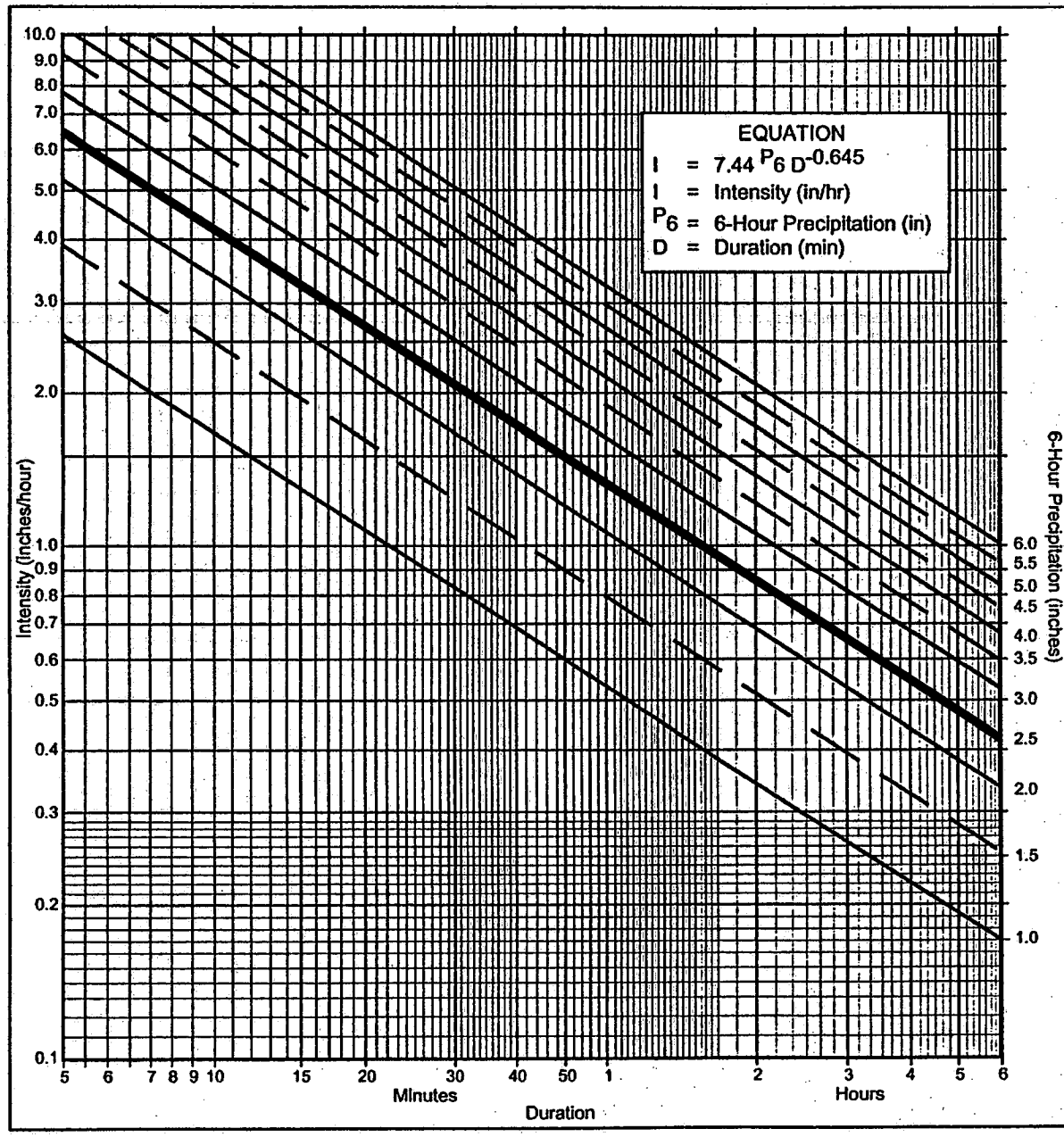
N
W E
S

3 0 3 Miles



Directions for Application:

(1) From precipitation maps determine 6 hr and 24 hr amounts for the selected frequency. These maps are included in the County Hydrology Manual (10, 50, and 100 yr maps included in the Design and Procedure Manual).

(2) Adjust 6 hr precipitation (if necessary) so that it is within the range of 45% to 65% of the 24 hr precipitation (not applicaple to Desert).

(3) Plot 6 hr precipitation on the right side of the chart.

(4) Draw a line through the point parallel to the plotted lines.

(5) This line is the intensity-duration curve for the location being analyzed.

Application Form:

(a) Selected frequency 100 year

(b) P_6 = 2.50 in., P_{24} = 5.50, $\frac{P_6}{P_{24}}$ = 45 %(2)

(c) Adjusted P_6(2) = 2.50 in.

(d) t_x = _____ min.

(e) I = _____ in./hr.

Note: This chart replaces the Intensity-Duration-Frequency curves used since 1965.

P6 / Duration	1	1.5	2	2.5	3	3.5	4	4.5	5	5.5	6
	I	I	I	I	I	I	I	I	I	I	I
5	2.63	3.95	5.27	6.59	7.90	9.22	10.54	11.86	13.17	14.49	15.81
7	2.12	3.18	4.24	5.30	6.36	7.42	8.48	9.54	10.60	11.66	12.72
10	1.68	2.53	3.37	4.21	5.05	5.90	6.74	7.58	8.42	9.27	10.11
15	1.30	1.95	2.59	3.24	3.89	4.54	5.19	5.84	6.49	7.13	7.78
20	1.08	1.62	2.15	2.69	3.23	3.77	4.31	4.85	5.39	5.93	6.46
25	0.93	1.40	1.87	2.33	2.80	3.27	3.73	4.20	4.67	5.13	5.60
30	0.83	1.24	1.66	2.07	2.49	2.90	3.32	3.73	4.15	4.56	4.98
40	0.69	1.03	1.38	1.72	2.07	2.41	2.76	3.10	3.45	3.79	4.13
50	0.60	0.90	1.19	1.49	1.79	2.09	2.39	2.69	2.98	3.28	3.58
60	0.53	0.80	1.06	1.33	1.59	1.86	2.12	2.39	2.65	2.92	3.18
90	0.41	0.61	0.82	1.02	1.23	1.43	1.63	1.84	2.04	2.25	2.45
120	0.34	0.51	0.68	0.85	1.02	1.19	1.36	1.53	1.70	1.87	2.04
150	0.29	0.44	0.59	0.73	0.88	1.03	1.18	1.32	1.47	1.62	1.76
180	0.26	0.39	0.52	0.65	0.78	0.91	1.04	1.18	1.31	1.44	1.57
240	0.22	0.33	0.43	0.54	0.65	0.76	0.87	0.98	1.08	1.19	1.30
300	0.19	0.28	0.38	0.47	0.56	0.66	0.75	0.85	0.94	1.03	1.13
360	0.17	0.25	0.33	0.42	0.50	0.58	0.67	0.75	0.84	0.92	1.00

Intensity-Duration Design Chart - Template

FIGURE 3-1

APPENDIX 2

Existing Conditions – Excerpts From Caltrans Report & Drainage Plans

PROJECT DESIGN CONSULTANTS

PLANNING | LANDSCAPE ARCHITECTURE
ENVIRONMENTAL | ENGINEERING | SURVEY

WWW.PROJECTDESIGN.COM

PROJECT CA Crossings
SUBJECT "Backbone" Drainage Condition

PAGE : 1 OF 1 JOB NO. : 3315
DRAWN BY : _____ DATE : _____
CHECKED BY : _____ DATE : _____

Summary of Drainage Calculations from Caltrans Report

Watershed TAI = 244144 m^2 per exhibit

$$= 244144\ m^2 \left(\frac{ft^2}{(0.3048m)^2}\right)\left(\frac{ac}{43560\ ft^2}\right)$$

$$= 60.33 \text{ acres}$$

Q100 — From Reference in Caltrans Report

95.3 cfs [2.7 cms] — Summary of Peak Discharge Table.

101.8 cfs [2.884 cms] — WSPG run; modeled each barrel separately $\frac{Q}{barrel} = 1.442$ cms

96.6 cfs [2.735 cms] — FHWA Nomograph for culvert inlet control

→ Not sure why Qs are all slightly different, but we will use the lowest Q (95.3 cfs) in order to be conservative.

DESCRIPTION

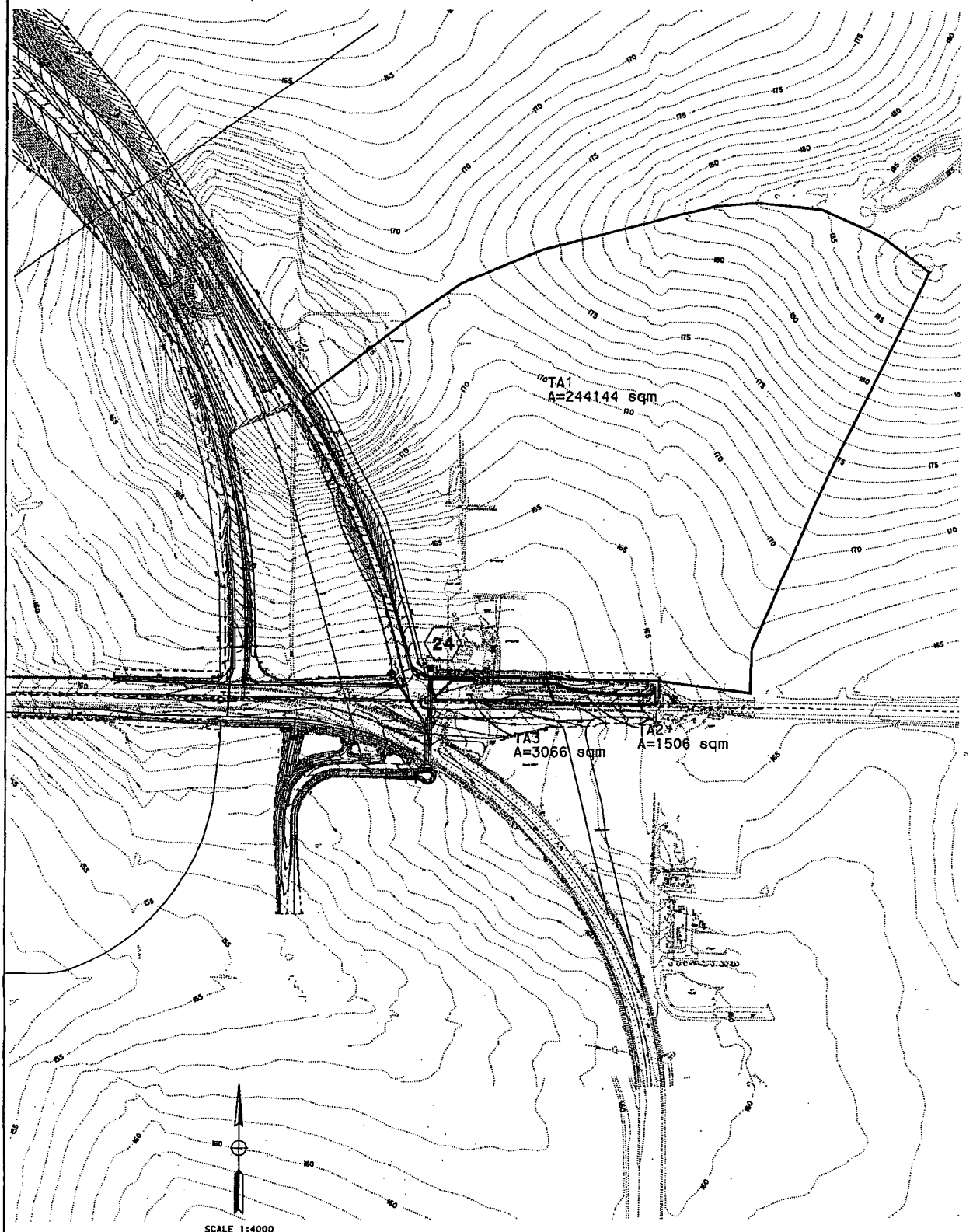
This study is an addendum to the Drainage Report for SR-125 South Toll Road Segment 1A and presents a hydrologic and hydraulic analysis for the drainage systems for Otay Mesa Road from Piper Ranch Road to Harvest Road. The following calculations are included in this report: Peak discharge calculations; Culvert inlet and outlet control calculations; Grate inlet calculations; Pipe flow calculations; Bioswale calculations; and Ditch calculations. For design methodologies for these calculations refer to the Drainage Report for SR-125 South Toll Road Segment 1A. The following drainage systems are proposed:

- **System 24:** Includes both off-site and on-site runoff. Off-site runoff is conveyed through pre-cast double box culverts. On-site flows from Otay Mesa Road are collected in inlets and discharged into the box culverts. Flows received from the proposed Sunroad development are also discharged into this system. Water Surface Pressure Gradient Package (WSPGW) is used to analyze the box culverts. System 24 outlets into a grass lined flood control channel designed to convey the 100-year storm event. As the channel depth decreases and meets existing grade, the runoff will follow natural drainage patterns to the southwest, and ultimately drains into an existing drainage channel west of La Media Road.
- **System 25:** Includes both off-site and on-site runoff. Off-site runoff from the infield area between Ramps OM1 and OM4 is conveyed through a single pre-cast box culvert. Additional on-site runoff from Otay Mesa Road and Ramp OM1 are collected in ditches and discharged into the box culvert. Water Surface Pressure Gradient Package (WSPGW) is used to analyze the box culvert. System 25 outlets into the same flood control channel as System 24.
- **System 26:** On-site flows from Otay Mesa Road are discharged through an overside drain and treated with a bioswale.
- **System 27:** Includes on-site runoff from Otay Mesa Road and Ramp OM4 collected in inlets. System 27 is discharged into a flood control channel and combined with flows from Systems 28 and 29 to be treated through a bioswale at the outlet.

LEGEND:

⟨1⟩ SYSTEM

—— WATERSHED BOUNDARY



SCALE 1:4000

SR 125 TOLL ROAD
SYSTEM 24
OTAY MESA ROAD
TRIBUTARY AREAS

JOB: 14464A
DATE: APRIL 9, 2007

RICK ENGINEERING COMPANY
TRANSPORTATION DIVISION

Perpared by: ves
Checked by.J. Jaro
Date: 4/10/2007

Summary of Peak Discharge

ID	Peak Discharge (Q_{10})		Peak Discharge (Q_{25})		Peak Discharge (Q_{50})		Peak Discharge (Q_{100})	
	CFS	CMS	CFS	CMS	CFS	CMS	CFS	CMS
TA1 - Watershed A	51.079	1.446	68.105	1.928	88.536	2.507	95.347	2.700
TA2 - System 24h	0.802	0.023	0.997	0.028	1.141	0.032	1.285	0.036
TA3 - System 24m+r	1.632	0.046	2.030	0.057	2.323	0.066	2.616	0.074
TOTAL	**53.513**	**1.515**	**71.132**	**2.014**	**92.001**	**2.605**	**99.248**	**2.810**

Notes:

1. To be conservative, it is assumed that discharge from offsite and on-site tributary areas reaches the culvert inlet simultaneously.
2. Peak discharge from watersheds A is calculated based on existing condition. Both City of San Diego and San Diego County require future land developers to detain peak discharge on site.
3. ***Within the watershed A, a portion of the tributary area will be developed and will become Sunroad Tech Center. Therefore, some runoff will be conveyed through a 36" RCP to System 24. However, the total discharge of the system 24 remains same at the very downstream since the future development will limit the discharge to existing flow rate through storm water detention.***
4. Based on the information provided by Stevens.Cresto Engineering Inc., the discharge of 10-year, 25-year and 100-year flood from the 36" RCP is: Q_{10}=0.44 cms; Q_{25}=0.56 cms, Q_{100}=0.74 cms.

```
T1 Otay Mesa Road double box- west of 2 boxes (no lateral); total Q= 1.442 cms 1
T2 starting wsel= 159.956 (from downstream channel run)
T3 J-14464s 04/02/07
SO    1000.000 159.572  1                                  159.956
R     1094.764 160.044  1       .013                                        .000     .000 0
WE    1094.764 160.044  2       .500
SH    1094.764 160.044  2                                  160.044
CD    1  3    0     .000     .600    1.830  .000  .000    .00
CD    2  1    0     .000   10.000   10.000  .000  .000    .00
Q                 1.442    .0
```

W S P G W - CIVILDESIGN Version 14.05

Program Package Serial Number: 1462

WATER SURFACE PROFILE LISTING

Date: 4- 4-2007 Time:10:41:27

Otay Mesa Road double box- west of 2 boxes (no lateral); total Q= 1.442 cm
starting wsel= 159.956 (from downstream channel run)
J-14464s 04/02/07

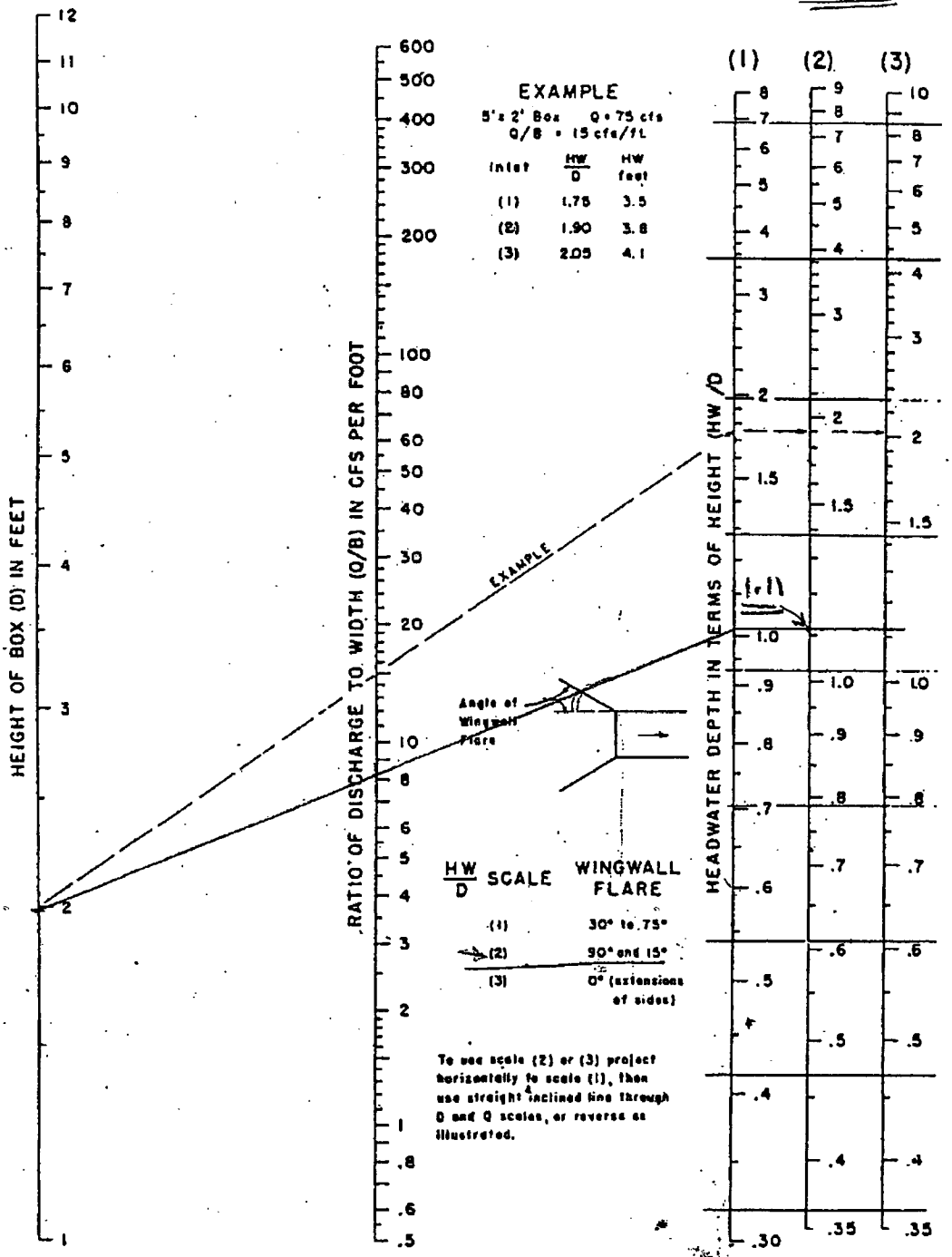
Station	Invert Elev	Depth (M)	Water Elev	Q (M3/S)	Vel (M/S)	Vel Head	Energy Grd.El.	Super Elev	Critical Depth	Flow Width	Dia.-M or I.D.	Top Height/ZL	Base Wt|Prs/Pip	No Wth	L/Elem | X-Fall	Ch Slope ZR	Type Ch	SF Ave	HF	SE Dpth	Froude N	Norm Dp	"N"
1000.000	159.572	.359	159.931	1.442	2.20	.25	160.18	.00	.40	1.83	.600	1.830	.00	0	.0								
65.586																.0050		.0050	.33	.36	1.17	.36	.013	.00	.00	BOX																							
1065.586	159.899	.359	160.257	1.442	2.20	.25	160.50	.00	.40	1.83	.600	1.830	.00	0	.0								
17.602																.0050		.0049	.09	.36	1.17	.36	.013	.00	.00	BOX																							
1083.188	159.986	.361	160.348	1.442	2.18	.24	160.59	.00	.40	1.83	.600	1.830	.00	0	.0								

```
    10.095    .0050                                                .0045      .05      .36     1.16      .36     .013
.00    .00  BOX
          |         |        |         |         |                  |         |        |        |         |
|       |     |
  1093.282   160.037     .379   160.416     1.442    2.08     .22   160.64     .00      .40     1.83.     .600
1.830    .00    0    .0
          -|-       -|-      -|-       -|-      -|-      -|-      -|-       -|-      -|-      -|-       -|-
-|-      -|-      |-
     1.482    .0050                                                .0039      .01      .38     1.08      .36     .013
.00    .00  BOX
          |         |        |         |         |                  |         |        |        |         |
|       |     |
  1094.764   160.044     .399   160.443     1.442    1.98     .20   160.64     .00      .40     1.83      .600
1.830    .00    0    .0
          -|-       -|-      -|-       -|-      -|-      -|-      -|-       -|-      -|-      -|-       -|-
-|-      -|-      |-
  WALL  ENTRANCE
          |         |        |         |         |                  |         |        |        |         |
|       |     |
  1094.764   160.044     .694   160.738     1.442     .21     .00   160.74     .00      .13    10.00    10.000
10.000    .00    0    .0
          -|-       -|-      -|-       -|-      -|-      -|-      -|-       -|-      -|-      -|-       -|-
-|-      -|-      |-
```

Double box Culvert (Sys 24)

$\frac{HW}{D} = 1.11$ $\therefore HW = 1.11 \times 1.968$
$= 2.18'$
$= 0.67m$

CHART 8



HEADWATER DEPTH FOR BOX CULVERTS WITH INLET CONTROL

BUREAU OF PUBLIC ROADS JAN. 1963

Considering 2 boxes as one

$Q = 2.735 cms = 96.6 cfs$

$\therefore \frac{Q}{B} = \frac{2.735}{1.8 \times 2} = 0.76 \ m^2/s = 8.18 \ ft^2/s$

$D = 0.6m = 1.968'$

DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET No.	TOTAL SHEETS
11	SD	125	2.7/8.2		

REGISTERED CIVIL ENGINEER XXXXXXX DATE

REGISTERED PROFESSIONAL ENGINEER — EA CAMERINO — No. 58844 — Exp. 6-30-07 — CIVIL — STATE OF CALIFORNIA

PLANS APPROVAL DATE

California Transportation Ventures, Inc.
880 Kuhn Drive
Chula Vista, CA 91914

Rick Engineering Company
5620 Friars Road
San Diego, CA 92110

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Caltrans Metric

DATE	REVISED BY	DATE REVISED

CALCULATED/DESIGNED BY

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DESIGN OVERSIGHT — RAMON MARTINEZ

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION

MATCH LINE STA 28+20 "A" LINE SEE SHEET D-4

MATCH LINE STA 9+60 "OM" LINE SEE SHEET D-1

MATCH LINE STA 12+50 "OM" LINE SEE SHEET D-3

"A" LINE ROUTE 125

"OM1" LINE

"OM4" LINE

"OM" LINE OTAY MESA Rd

SAN DIEGO COUNTY

CITY OF SAN DIEGO

25 (p) Conc DITCH (TYPE A) SEE DD-5

FC 11.238 Rt "OM4" 28+14.207

R= 34.410

BC 46.394 Rt "OM4" 27+79.177

10.172 Lt "OM1" 27+18.650 END Conc DITCH (TYPE A)

28.353 Lt "OM" 11+60.050 BEGIN Conc DITCH (TYPE A)

24 (p) Conc DITCH (TYPE A) SEE DD-5

26.930 Rt "OM1" 27+12.131 END Conc DITCH (TYPE A)

RSP SEE DD-37

TCE

REMOVE Exist RCB

REMOVE Exist HEADWALL

REMOVE Exist ENDWALL

REMOVE Exist RCP CULVERT

REMOVE Exist HEADWALL

REMOVE Exist Conc APRON

GRADE TO DRAIN

31.164 Rt "OM" 11+20.000

42.664 Rt "OM" 11+60.000

OSD SEE DD-38

OSD SEE DD-39

RSP SEE DD-37

BIOSWALE, SEE DD-39

OUTLET CHANNEL, SEE DD-39

24 (k) RSP SEE DD-37

24 (a) SEE DD-37

ISSUE RECORD		
No.	PURPOSE	DATE
0	RELEASED FOR CONSTRUCTION	05SEP05
1	RFR C-044	XXXXXXX

THIS PLAN ACCURATE FOR DRAINAGE WORK ONLY

ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE SHOWN

24 25 27 28 29

DRAINAGE PLAN

SCALE 1:500

D-2

LAST REVISION DATE PLOTTED => 25-APR-2007
TIME PLOTTED => 14:12

DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET No.	TOTAL SHEETS
11	SD	125	2.7/8.2		

Caltrans Metric

Elyn A. Camerino XXXXXXX
REGISTERED CIVIL ENGINEER DATE

REGISTERED PROFESSIONAL ENGINEER
EA CAMERINO
No. 58844
EXP. 6-30-07
CIVIL
STATE OF CALIFORNIA

PLANS APPROVAL DATE

California Transportation Ventures, Inc.
880 Kuhn Drive
Chula Vista, CA 91914

Rick Engineering Company
5620 Friars Road
San Diego, CA 92110

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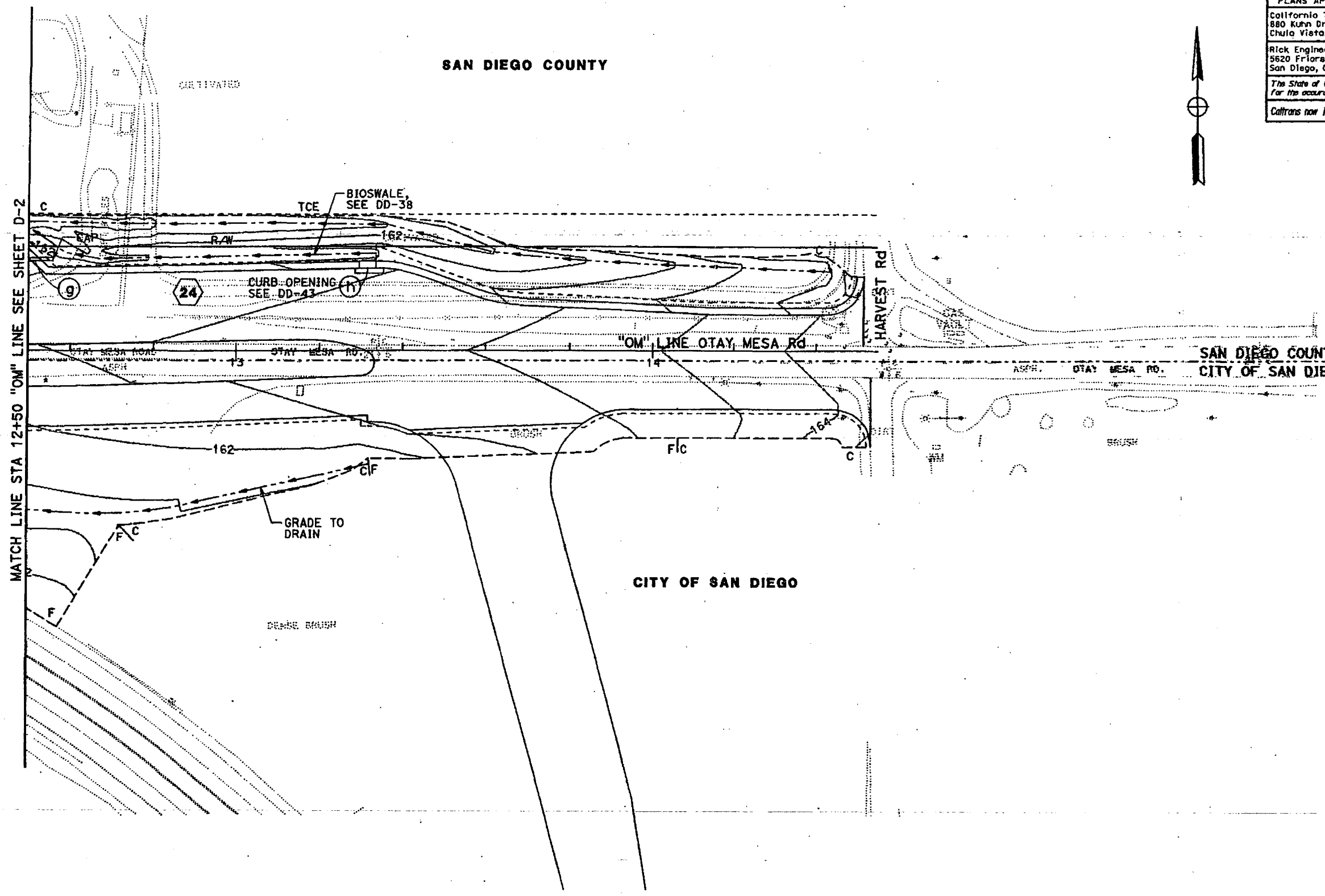
STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
Caltrans

ISSUE RECORD		
No.	PURPOSE	DATE
0	RELEASED FOR CONST. (RFR C-044)	XXXXXXX

SAN DIEGO COUNTY



24

DRAINAGE PLAN

SCALE 1:500

D-3

THIS PLAN ACCURATE FOR DRAINAGE WORK ONLY.

ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE SHOWN

AS-BUILT REVISIONS
DATE PLOTTED => 25-APR-2007
TIME PLOTTED => 12:02

@FILE@

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION	DESIGN OVERSIGHT	CALCULATED/ DESIGNED BY		DATE	REVISED BY								
Caltrans	RAMON MARTINEZ	CHECKED BY			DATE REVISED								

ISSUE RECORD			
NO.	PURPOSE	DATE	
0	RELEASED FOR CONSTRUCTION	08SEP05	
1	RFA C-044	XXXXXXX	

MATCH LINE STA 28+20 "A" LINE SEE SHEET D-2

"A" LINE ROUTE 125

"OM1" LINE

"OM4" LINE

R/W

C/F

24 (P) Conc DITCH (TYPE A) SEE DD-5

24 (Q) Conc DITCH (TYPE A) SEE DD-5

25 (P) Conc DITCH (TYPE A) SEE DD-5

26 (Q)

18,698 Rt "OM1" 29+23.861
Conc DITCH CONFLUENCE (TYPE 2)
WITH SPLASH WALL
θ = 33°
FL 169.806, SEE DD-6

10,302 Lt "OM1" 29+37.240
END Conc DITCH (TYPE A)

OSD, SEE DD-38

9,600 Rt "OM1" 29+37.445
SIDE GUTTER TO
Conc DITCH TRANSITION
FL 171.584
SEE DD-29

10,796 Rt "OM4" 30+46.398
END Conc DITCH (TYPE A)

22,388 Rt
OM1 30+30.689
HIGH POINT
FL 175.502

29 30 31 164 166 168 170 172 174 176

THIS PLAN ACCURATE FOR DRAINAGE WORK ONLY

ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE SHOWN

DRAINAGE PLAN

SCALE 1:500

D-4

24 25

Caltrans Metric

DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET No.	TOTAL SHEETS
11	SD	125	2.7/8.2		

REGISTERED CIVIL ENGINEER XXXXXXX DATE

PLANS APPROVAL DATE

California Transportation Ventures, Inc.
880 Kuhn Drive
Chula Vista, CA 91914

Rick Engineering Company
5620 Friars Road
San Diego, CA 92110

REGISTERED PROFESSIONAL ENGINEER
E.A. CAMERINO
No. 58844
Exp. 6-30-07
CIVIL
STATE OF CALIFORNIA

LAST REVISION	DATE PLOTTED => 25-APR-2007	#FILE#
04-25-07	TIME PLOTTED => 14:11	

DRAINAGE SYSTEM (24)

(a) DROP STRUCTURE / STILLING BASIN, SEE DD-37

(b) BOX CULVERT WINGWALLS, H= 1.08, m=3.297, θ=15°

(c) 1.8 m x 0.6 m x 94.45 PRECAST DOUBLE RCB CULVERT, SEE DD-37 TO DD-39

(d) 600 mm x 28.9 APC (TYPE A)

(e) 600 mm x 26.8 APC (TYPE A)

(n) BOX CULVERT WINGWALLS, H=2.081, m=5.696, θ=15°

(m) MOD GDO INLET, H=1.15, SEE DD-35

(o) RSP BACKING No. 2, SEE DD-37

(r) 4m GRATED LINE DRAIN WITH REMOVABLE GRATES

Caltrans Metric

DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET No.	TOTAL SHEETS
11	SD	125	2.7/8.2		

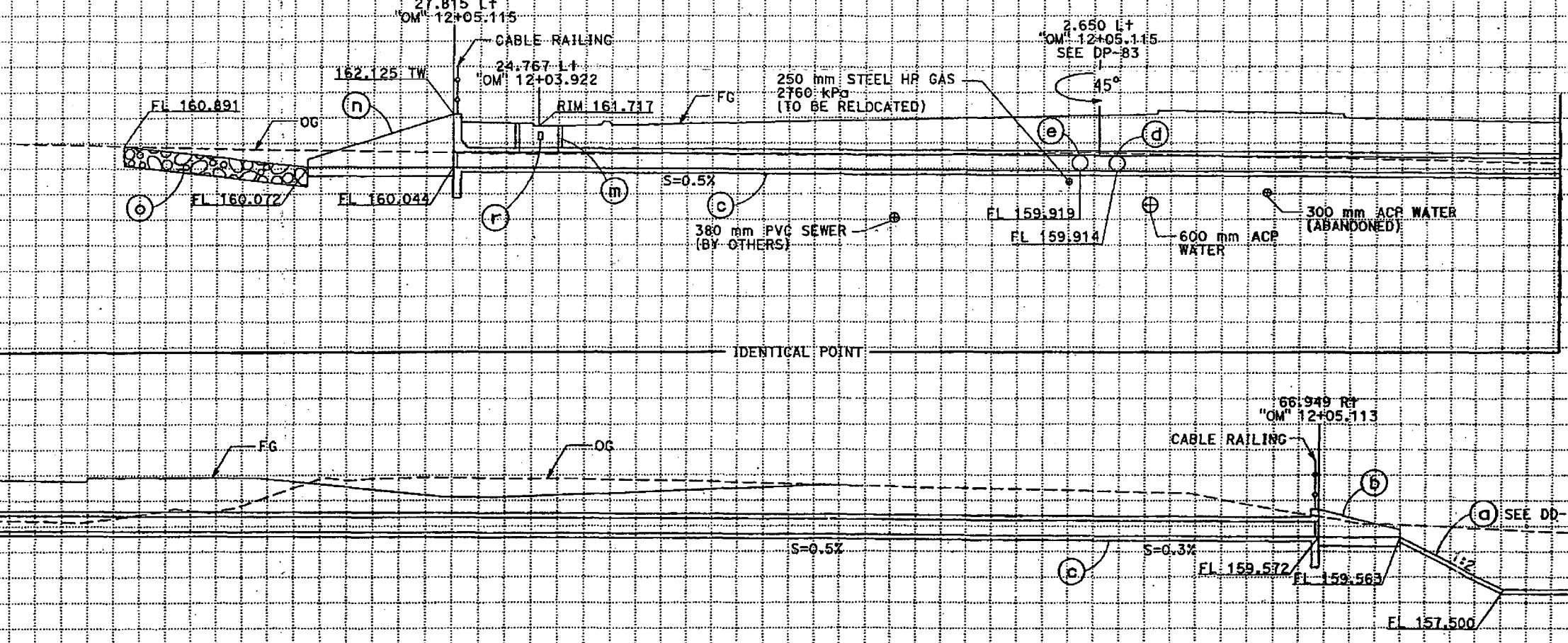
XXXXXXX
REGISTERED CIVIL ENGINEER DATE

EA CAMERINO
No. 58844
Exp. 6-30-07
CIVIL
REGISTERED PROFESSIONAL ENGINEER
STATE OF CALIFORNIA

PLANS APPROVAL DATE

California Transportation Ventures, Inc
880 Kuhn Drive
Chula Vista, CA 91914

Rick Engineering Company
5620 Friars Road
San Diego, CA 92110



DRAINAGE PROFILE

SCALE 1:100

DP-82

ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE SHOWN

ISSUE RECORD		
No.	PURPOSE	DATE
0	RELEASED FOR CONST. (RFR C-044)	XXXXXXX

DESIGN OVERSIGHT: RAMON MARTINEZ

CALCULATED/DESIGNED BY

CHECKED BY

DATE REVISED

REVISED BY

DATE

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION

Station

m^3 Exc

Emb

FOR REDUCED PLANS ORIGINAL 0 20 40 60 80

LAST REVISION 04-25-07

DATE PLOTTED => 25-APR-2007

TIME PLOTTED => 14:05

FILE#

APPENDIX 3

Proposed Conditions Rational Method Computer Output

San Diego County Rational Hydrology Program

CIVILCADD/CIVILDESIGN Engineering Software,(c)1991-2004 Version 7.4

Rational method hydrology program based on
San Diego County Flood Control Division 2003 hydrology manual
Rational Hydrology Study Date: 03/20/08

PDC JOB 3315 CALIFORNIA CROSSINGS
ONSITE 100 YEAR FLOWS
SYSTEM 100
PROPOSED CONDITIONS, FILE: S100P100

********* Hydrology Study Control Information **********

Program License Serial Number 4049

Rational hydrology study storm event year is 100.0
English (in-lb) input data Units used

Map data precipitation entered:
6 hour, precipitation(inches) = 2.500
24 hour precipitation(inches) = 5.500
P6/P24 = 45.5%
San Diego hydrology manual 'C' values used

++
Process from Point/Station 100.000 to Point/Station 100.000
**** INITIAL AREA EVALUATION ****

Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[INDUSTRIAL area type]
(General Industrial)
Impervious value, Ai = 0.950
Sub-Area C Value = 0.870
Initial subarea total flow distance = 100.000(Ft.)
Highest elevation = 545.000(Ft.)
Lowest elevation = 544.000(Ft.)
Elevation difference = 1.000(Ft.) Slope = 1.000 %
USER ENTRY OF INITIAL AREA TIME OF CONCENTRATION
Time of Concentration = 5.00 minutes
Rainfall intensity (I) = 6.587(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.870
Subarea runoff = 15.931(CFS)
Total initial stream area = 2.780(Ac.)

++
Process from Point/Station 100.000 to Point/Station 117.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****

Upstream point/station elevation = 550.900(Ft.)
Downstream point/station elevation = 539.800(Ft.)
Pipe length = 487.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 15.931(CFS)
Nearest computed pipe diameter = 21.00(In.)
Calculated individual pipe flow = 15.931(CFS)
Normal flow depth in pipe = 12.53(In.)
Flow top width inside pipe = 20.60(In.)
Critical Depth = 17.67(In.)
Pipe flow velocity = 10.64(Ft/s)
Travel time through pipe = 0.76 min.
Time of concentration (TC) = 5.76 min.

++
Process from Point/Station 110.000 to Point/Station 117.000
**** CONFLUENCE OF MINOR STREAMS ****

Along Main Stream number: 1 in normal stream number 1
Stream flow area = 2.780(Ac.)
Runoff from this stream = 15.931(CFS)

```
Time of concentration =    5.76 min.
Rainfall intensity =     6.011(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      105.000 to Point/Station      117.000
**** INITIAL AREA EVALUATION ****
------------------------------------------------------------------------------
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[INDUSTRIAL area type                         ]
(General Industrial       )
Impervious value, Ai = 0.950
Sub-Area C Value = 0.870
Initial subarea total flow distance  =  775.000(Ft.)
Highest elevation =  555.000(Ft.)
Lowest elevation =  543.800(Ft.)
Elevation difference =   11.200(Ft.) Slope =  1.445 %
INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
The maximum overland flow distance is 60.00 (Ft)
for the top area slope value of   1.45 %, in a development type of
 General Industrial
In Accordance With Figure 3-3
Initial Area Time of Concentration =   2.83 minutes
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.8700)*(  60.000^.5)/(   1.450^(1/3)]=   2.83
The initial area total distance of  775.00 (Ft.) entered leaves a
remaining distance of  715.00 (Ft.)
Using Figure 3-4, the travel time for this distance is   6.28 minutes
for a distance of 715.00 (Ft.) and a slope of  1.45 %
with an elevation difference of  10.37(Ft.) from the end of the top area
Tt = [11.9*length(Mi)^3)/(elevation change(Ft.))]^.385 *60(min/hr)
 =    6.285 Minutes
Tt=[(11.9*0.1354^3)/( 10.37)]^.385=  6.28
Total initial area Ti =   2.83 minutes from Figure 3-3 formula plus
  6.28 minutes from the Figure 3-4 formula =   9.12 minutes
Rainfall intensity (I) =     4.471(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.870
Subarea runoff =     10.191(CFS)
Total initial stream area =       2.620(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      105.000 to Point/Station      117.000
**** CONFLUENCE OF MINOR STREAMS ****
------------------------------------------------------------------------------
Along Main Stream number: 1 in normal stream number 2
Stream flow area =      2.620(Ac.)
Runoff from this stream =     10.191(CFS)
Time of concentration =    9.12 min.
Rainfall intensity =     4.471(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      112.000 to Point/Station      113.000
**** INITIAL AREA EVALUATION ****
------------------------------------------------------------------------------
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[INDUSTRIAL area type                         ]
(General Industrial       )
Impervious value, Ai = 0.950
Sub-Area C Value = 0.870
Initial subarea total flow distance  =  151.000(Ft.)
Highest elevation =  551.100(Ft.)
Lowest elevation =  548.900(Ft.)
Elevation difference =    2.200(Ft.) Slope =  1.457 %
USER ENTRY OF INITIAL AREA TIME OF CONCENTRATION
Time of Concentration =   5.00 minutes
Rainfall intensity (I) =     6.587(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.870
Subarea runoff =      4.642(CFS)
Total initial stream area =       0.810(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      113.000 to Point/Station      114.000
```

```
**** IMPROVED CHANNEL TRAVEL TIME ****
------------------------------------------------------------------------
Upstream point elevation =   548.900(Ft.)
Downstream point elevation =   543.000(Ft.)
Channel length thru subarea  =   215.500(Ft.)
Channel base width        =   20.000(Ft.)
Slope or 'Z' of left channel bank =  10.000
Slope or 'Z' of right channel bank =  10.000
Estimated mean flow rate at midpoint of channel =      6.549(CFS)
Manning's 'N'    = 0.015
Maximum depth of channel  =    1.000(Ft.)
Flow(q) thru subarea =      6.549(CFS)
Depth of flow =   0.095(Ft.), Average velocity =   3.304(Ft/s)
Channel flow top width =   21.893(Ft.)
Flow Velocity =   3.30(Ft/s)
Travel time  =    1.09 min.
Time of concentration =    6.09 min.
Critical depth =      0.146(Ft.)
 Adding area flow to channel
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[INDUSTRIAL area type                          ]
(General Industrial       )
Impervious value, Ai = 0.950
Sub-Area C Value = 0.870
Rainfall intensity =      5.802(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.870  CA =      1.444
Subarea runoff =      3.737(CFS) for      0.850(Ac.)
Total runoff =      8.379(CFS)    Total area =       1.660(Ac.)
Depth of flow =   0.110(Ft.), Average velocity =   3.627(Ft/s)
Critical depth =      0.172(Ft.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      113.000 to Point/Station      115.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
------------------------------------------------------------------------
Upstream point/station elevation =   543.000(Ft.)
Downstream point/station elevation =   541.400(Ft.)
Pipe length  =   272.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     8.379(CFS)
Nearest computed pipe diameter  =     21.00(In.)
Calculated individual pipe flow  =     8.379(CFS)
Normal flow depth in pipe =   12.82(In.)
Flow top width inside pipe =   20.48(In.)
Critical Depth =   12.90(In.)
Pipe flow velocity =      5.45(Ft/s)
Travel time through pipe =    0.83 min.
Time of concentration (TC) =     6.92 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      115.000 to Point/Station      115.000
**** SUBAREA FLOW ADDITION ****
------------------------------------------------------------------------
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[INDUSTRIAL area type                          ]
(General Industrial       )
Impervious value, Ai = 0.950
Sub-Area C Value = 0.870
Time of concentration =     6.92 min.
Rainfall intensity =      5.342(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.870  CA =      3.645
Subarea runoff =     11.093(CFS) for      2.530(Ac.)
Total runoff =     19.472(CFS)    Total area =       4.190(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      115.000 to Point/Station      117.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
------------------------------------------------------------------------
Upstream point/station elevation =   541.400(Ft.)
Downstream point/station elevation =   539.800(Ft.)
Pipe length  =   247.00(Ft.)   Manning's N = 0.013
```

```
No. of pipes = 1  Required pipe flow  =    19.472(CFS)
Nearest computed pipe diameter  =     27.00(In.)
Calculated individual pipe flow  =    19.472(CFS)
Normal flow depth in pipe =   17.95(In.)
Flow top width inside pipe =   25.49(In.)
Critical Depth =   18.52(In.)
Pipe flow velocity =      6.93(Ft/s)
Travel time through pipe =    0.59 min.
Time of concentration (TC) =     7.51 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      115.000 to Point/Station      117.000
**** CONFLUENCE OF MINOR STREAMS ****
----------------------------------------------------------------------------
Along Main Stream number: 1 in normal stream number 3
Stream flow area =      4.190(Ac.)
Runoff from this stream =     19.472(CFS)
Time of concentration =    7.51 min.
Rainfall intensity =     5.066(In/Hr)
Summary of stream data:

Stream    Flow rate      TC            Rainfall Intensity
 No.       (CFS)       (min)                 (In/Hr)


1       15.931      5.76           6.011
2       10.191      9.12           4.471
3       19.472      7.51           5.066
Qmax(1) =
           1.000 *    1.000 *    15.931) +
           1.000 *    0.632 *    10.191) +
           1.000 *    0.767 *    19.472) + =      37.308
Qmax(2) =
           0.744 *    1.000 *    15.931) +
           1.000 *    1.000 *    10.191) +
           0.883 *    1.000 *    19.472) + =      39.226
Qmax(3) =
           0.843 *    1.000 *    15.931) +
           1.000 *    0.824 *    10.191) +
           1.000 *    1.000 *    19.472) + =      41.295

Total of 3 streams to confluence:
Flow rates before confluence point:
     15.931      10.191      19.472
Maximum flow rates at confluence using above data:
      37.308      39.226      41.295
Area of streams before confluence:
       2.780       2.620       4.190
Results of confluence:
Total flow rate =     41.295(CFS)
Time of concentration =     7.513 min.
Effective stream area after confluence =      9.590(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      117.000 to Point/Station      120.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
----------------------------------------------------------------------------
Upstream point/station elevation =   539.800(Ft.)
Downstream point/station elevation =   537.500(Ft.)
Pipe length  =   283.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =    41.295(CFS)
Nearest computed pipe diameter  =     33.00(In.)
Calculated individual pipe flow  =    41.295(CFS)
Normal flow depth in pipe =   23.72(In.)
Flow top width inside pipe =   29.67(In.)
Critical Depth =   25.63(In.)
Pipe flow velocity =      9.04(Ft/s)
Travel time through pipe =    0.52 min.
Time of concentration (TC) =     8.03 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      120.000 to Point/Station      120.000
**** SUBAREA FLOW ADDITION ****
----------------------------------------------------------------------------
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
```

```
[COMMERCIAL area type                          ]
(General Commercial     )
Impervious value, Ai = 0.850
Sub-Area C Value = 0.820
Time of concentration =     8.03 min.
Rainfall intensity =      4.851(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.865  CA =      9.163
Subarea runoff =      3.154(CFS) for      1.000(Ac.)
Total runoff =     44.449(CFS)     Total area =      10.590(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      118.000 to Point/Station      120.000
**** SUBAREA FLOW ADDITION ****
------------------------------------------------------------------------------
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[INDUSTRIAL area type                          ]
(General Industrial       )
Impervious value, Ai = 0.950
Sub-Area C Value = 0.870
Time of concentration =     8.03 min.
Rainfall intensity =      4.851(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.866  CA =      9.964
Subarea runoff =      3.883(CFS) for      0.920(Ac.)
Total runoff =     48.332(CFS)     Total area =      11.510(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      120.000 to Point/Station      180.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
------------------------------------------------------------------------------
Upstream point/station elevation =   537.500(Ft.)
Downstream point/station elevation =   535.000(Ft.)
Pipe length  =   150.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =    48.332(CFS)
Nearest computed pipe diameter  =     30.00(In.)
Calculated individual pipe flow  =    48.332(CFS)
Normal flow depth in pipe =   22.50(In.)
Flow top width inside pipe =   25.98(In.)
Critical Depth =   27.33(In.)
Pipe flow velocity =     12.23(Ft/s)
Travel time through pipe =    0.20 min.
Time of concentration (TC) =     8.24 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      120.000 to Point/Station      180.000
**** CONFLUENCE OF MAIN STREAMS ****
------------------------------------------------------------------------------
The following data inside Main Stream is listed:
In Main Stream number: 1
Stream flow area =     11.510(Ac.)
Runoff from this stream =     48.332(CFS)
Time of concentration =    8.24 min.
Rainfall intensity =     4.773(In/Hr)
Program is now starting with Main Stream No. 2


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      150.000 to Point/Station      155.000
**** INITIAL AREA EVALUATION ****
------------------------------------------------------------------------------
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[INDUSTRIAL area type                          ]
(General Industrial       )
Impervious value, Ai = 0.950
Sub-Area C Value = 0.870
Initial subarea total flow distance  =  338.000(Ft.)
Highest elevation =  542.000(Ft.)
Lowest elevation =  536.500(Ft.)
Elevation difference =    5.500(Ft.) Slope =  1.627 %
INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
The maximum overland flow distance is 70.00 (Ft)
```

```
for the top area slope value of   1.63 %, in a development type of
 General Industrial
In Accordance With Figure 3-3
Initial Area Time of Concentration =   2.95 minutes
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.8700)*(  70.000^.5)/(   1.627^(1/3)]=   2.95
The initial area total distance of  338.00 (Ft.) entered leaves a
remaining distance of  268.00 (Ft.)
Using Figure 3-4, the travel time for this distance is   2.82 minutes
for a distance of 268.00 (Ft.) and a slope of  1.63 %
with an elevation difference of   4.36(Ft.) from the end of the top area
Tt = [11.9*length(Mi)^3)/(elevation change(Ft.))]^.385 *60(min/hr)
 =    2.824 Minutes
Tt=[(11.9*0.0508^3)/(  4.36)]^.385=  2.82
Total initial area Ti =   2.95 minutes from Figure 3-3 formula plus
  2.82 minutes from the Figure 3-4 formula =   5.77 minutes
Rainfall intensity (I) =      6.006(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.870
Subarea runoff =      8.152(CFS)
Total initial stream area =        1.560(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      155.000 to Point/Station      160.000
**** IMPROVED CHANNEL TRAVEL TIME ****
----------------------------------------------------------------------
Upstream point elevation =   536.500(Ft.)
Downstream point elevation =   535.000(Ft.)
Channel length thru subarea  =   160.000(Ft.)
Channel base width        =    5.000(Ft.)
Slope or 'Z' of left channel bank =   3.000
Slope or 'Z' of right channel bank =   3.000
Manning's 'N'    = 0.030
Maximum depth of channel  =    1.000(Ft.)
Flow(q) thru subarea =      8.152(CFS)
Depth of flow =   0.491(Ft.), Average velocity =   2.568(Ft/s)
Channel flow top width =    7.943(Ft.)
Flow Velocity =    2.57(Ft/s)
Travel time  =    1.04 min.
Time of concentration =    6.81 min.
Critical depth =      0.398(Ft.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      157.000 to Point/Station      160.000
**** SUBAREA FLOW ADDITION ****
----------------------------------------------------------------------
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[COMMERCIAL area type                        ]
(General Commercial    )
Impervious value, Ai = 0.850
Sub-Area C Value = 0.820
Time of concentration =     6.81 min.
Rainfall intensity =      5.398(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.847  CA =      2.481
Subarea runoff =      5.239(CFS) for      1.370(Ac.)
Total runoff =     13.390(CFS)    Total area =       2.930(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      160.000 to Point/Station      165.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
----------------------------------------------------------------------
Upstream point/station elevation =   533.000(Ft.)
Downstream point/station elevation =   532.000(Ft.)
Pipe length  =   103.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =    13.390(CFS)
Nearest computed pipe diameter  =    21.00(In.)
Calculated individual pipe flow  =    13.390(CFS)
Normal flow depth in pipe =   14.98(In.)
Flow top width inside pipe =   19.00(In.)
Critical Depth =   16.34(In.)
Pipe flow velocity =      7.30(Ft/s)
Travel time through pipe =    0.24 min.
Time of concentration (TC) =     7.04 min.
```

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++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      160.000 to Point/Station      165.000
**** CONFLUENCE OF MINOR STREAMS ****
----------------------------------------------------------------------------
Along Main Stream number: 2 in normal stream number 1
Stream flow area =      2.930(Ac.)
Runoff from this stream =      13.390(CFS)
Time of concentration =     7.04 min.
Rainfall intensity =      5.281(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      161.000 to Point/Station      162.000
**** INITIAL AREA EVALUATION ****
----------------------------------------------------------------------------
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[INDUSTRIAL area type                          ]
(General Industrial        )
Impervious value, Ai = 0.950
Sub-Area C Value = 0.870
Initial subarea total flow distance  =  148.000(Ft.)
Highest elevation =  551.000(Ft.)
Lowest elevation =  548.900(Ft.)
Elevation difference =    2.100(Ft.) Slope =  1.419 %
USER ENTRY OF INITIAL AREA TIME OF CONCENTRATION
Time of Concentration =   5.00 minutes
Rainfall intensity (I) =      6.587(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.870
Subarea runoff =      1.089(CFS)
Total initial stream area =        0.190(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      162.000 to Point/Station      165.000
**** IMPROVED CHANNEL TRAVEL TIME ****
----------------------------------------------------------------------------
Upstream point elevation =   548.900(Ft.)
Downstream point elevation =   535.000(Ft.)
Channel length thru subarea  =   674.000(Ft.)
Channel base width        =   20.000(Ft.)
Slope or 'Z' of left channel bank =  50.000
Slope or 'Z' of right channel bank =  50.000
Estimated mean flow rate at midpoint of channel =      3.444(CFS)
Manning's 'N'    = 0.015
Maximum depth of channel  =    1.000(Ft.)
Flow(q) thru subarea =      3.444(CFS)
Depth of flow =   0.068(Ft.), Average velocity =   2.165(Ft/s)
Channel flow top width =   26.798(Ft.)
Flow Velocity =    2.16(Ft/s)
Travel time  =    5.19 min.
Time of concentration =   10.19 min.
Critical depth =      0.090(Ft.)
 Adding area flow to channel
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[INDUSTRIAL area type                          ]
(General Industrial        )
Impervious value, Ai = 0.950
Sub-Area C Value = 0.870
Rainfall intensity =      4.162(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.870  CA =      1.375
Subarea runoff =      4.632(CFS) for      1.390(Ac.)
Total runoff =      5.721(CFS)    Total area =       1.580(Ac.)
Depth of flow =   0.091(Ft.), Average velocity =   2.567(Ft/s)
Critical depth =      0.123(Ft.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      162.000 to Point/Station      165.000
**** CONFLUENCE OF MINOR STREAMS ****
----------------------------------------------------------------------------
Along Main Stream number: 2 in normal stream number 2
Stream flow area =      1.580(Ac.)
Runoff from this stream =      5.721(CFS)
Time of concentration =   10.19 min.
```

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Rainfall intensity =     4.162(In/Hr)

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Process from Point/Station      163.000 to Point/Station      164.000
**** INITIAL AREA EVALUATION ****
------------------------------------------------------------------------
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[INDUSTRIAL area type                    ]
(General Industrial       )
Impervious value, Ai = 0.950
Sub-Area C Value = 0.870
Initial subarea total flow distance  =  460.000(Ft.)
Highest elevation =  543.800(Ft.)
Lowest elevation =  537.900(Ft.)
Elevation difference =    5.900(Ft.) Slope =  1.283 %
INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
The maximum overland flow distance is 60.00 (Ft)
for the top area slope value of   1.28 %, in a development type of
 General Industrial
In Accordance With Figure 3-3
Initial Area Time of Concentration =   2.95 minutes
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.8700)*(  60.000^.5)/(   1.280^(1/3)]=   2.95
The initial area total distance of  460.00 (Ft.) entered leaves a
remaining distance of  400.00 (Ft.)
Using Figure 3-4, the travel time for this distance is   4.22 minutes
for a distance of 400.00 (Ft.) and a slope of  1.28 %
with an elevation difference of   5.12(Ft.) from the end of the top area
Tt = [11.9*length(Mi)^3)/(elevation change(Ft.))]^.385 *60(min/hr)
 =    4.216 Minutes
Tt=[(11.9*0.0758^3)/(  5.12)]^.385=  4.22
Total initial area Ti =   2.95 minutes from Figure 3-3 formula plus
  4.22 minutes from the Figure 3-4 formula =   7.17 minutes
Rainfall intensity (I) =     5.221(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.870
Subarea runoff =      8.085(CFS)
Total initial stream area =       1.780(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      164.000 to Point/Station      165.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
------------------------------------------------------------------------
Upstream point/station elevation =   534.000(Ft.)
Downstream point/station elevation =   530.000(Ft.)
Pipe length  =   104.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     8.085(CFS)
Nearest computed pipe diameter  =     15.00(In.)
Calculated individual pipe flow  =     8.085(CFS)
Normal flow depth in pipe =    8.71(In.)
Flow top width inside pipe =   14.80(In.)
Critical Depth =   13.42(In.)
Pipe flow velocity =     10.95(Ft/s)
Travel time through pipe =    0.16 min.
Time of concentration (TC) =     7.33 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      164.000 to Point/Station      165.000
**** CONFLUENCE OF MINOR STREAMS ****
------------------------------------------------------------------------
Along Main Stream number: 2 in normal stream number 3
Stream flow area =      1.780(Ac.)
Runoff from this stream =      8.085(CFS)
Time of concentration =    7.33 min.
Rainfall intensity =     5.148(In/Hr)
Summary of stream data:

Stream   Flow rate      TC            Rainfall Intensity
 No.       (CFS)       (min)               (In/Hr)


1       13.390      7.04           5.281
2        5.721     10.19           4.162
3        8.085      7.33           5.148
Qmax(1) =
           1.000 *    1.000 *    13.390) +
```

```
            1.000 *    0.691 *     5.721) +
            1.000 *    0.961 *     8.085) + =      25.115
Qmax(2) =
            0.788 *    1.000 *    13.390) +
            1.000 *    1.000 *     5.721) +
            0.808 *    1.000 *     8.085) + =      22.809
Qmax(3) =
            0.975 *    1.000 *    13.390) +
            1.000 *    0.719 *     5.721) +
            1.000 *    1.000 *     8.085) + =      25.251

Total of 3 streams to confluence:
Flow rates before confluence point:
      13.390       5.721       8.085
Maximum flow rates at confluence using above data:
       25.115       22.809       25.251
Area of streams before confluence:
        2.930        1.580        1.780
Results of confluence:
Total flow rate =     25.251(CFS)
Time of concentration =     7.328 min.
Effective stream area after confluence =      6.290(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      165.000 to Point/Station      180.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
------------------------------------------------------------------------
Upstream point/station elevation =   532.000(Ft.)
Downstream point/station elevation =   530.000(Ft.)
Pipe length  =   200.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =    25.251(CFS)
Nearest computed pipe diameter  =     27.00(In.)
Calculated individual pipe flow  =    25.251(CFS)
Normal flow depth in pipe =   18.52(In.)
Flow top width inside pipe =   25.07(In.)
Critical Depth =   21.07(In.)
Pipe flow velocity =      8.68(Ft/s)
Travel time through pipe =    0.38 min.
Time of concentration (TC) =     7.71 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      165.000 to Point/Station      180.000
**** CONFLUENCE OF MAIN STREAMS ****
------------------------------------------------------------------------
The following data inside Main Stream is listed:
In Main Stream number: 2
Stream flow area =      6.290(Ac.)
Runoff from this stream =     25.251(CFS)
Time of concentration =    7.71 min.
Rainfall intensity =     4.981(In/Hr)
Program is now starting with Main Stream No. 3


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      170.000 to Point/Station      180.000
**** INITIAL AREA EVALUATION ****
------------------------------------------------------------------------
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[COMMERCIAL area type                    ]
(General Commercial    )
Impervious value, Ai = 0.850
Sub-Area C Value = 0.820
Initial subarea total flow distance  =  330.000(Ft.)
Highest elevation =  543.000(Ft.)
Lowest elevation =  538.000(Ft.)
Elevation difference =    5.000(Ft.) Slope =  1.515 %
INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
The maximum overland flow distance is 75.00 (Ft)
for the top area slope value of   1.52 %, in a development type of
 General Commercial
In Accordance With Figure 3-3
Initial Area Time of Concentration =   3.80 minutes
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.8200)*(  75.000^.5)/(   1.520^(1/3)]=   3.80
The initial area total distance of  330.00 (Ft.) entered leaves a
remaining distance of  255.00 (Ft.)
```

```
Using Figure 3-4, the travel time for this distance is   2.79 minutes
for a distance of 255.00 (Ft.) and a slope of  1.52 %
with an elevation difference of   3.88(Ft.) from the end of the top area
Tt = [11.9*length(Mi)^3)/(elevation change(Ft.))]^.385 *60(min/hr)
 =    2.790 Minutes
Tt=[(11.9*0.0483^3)/(  3.88)]^.385=  2.79
Total initial area Ti =   3.80 minutes from Figure 3-3 formula plus
  2.79 minutes from the Figure 3-4 formula =   6.59 minutes
Rainfall intensity (I) =      5.514(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.820
Subarea runoff =      9.450(CFS)
Total initial stream area =        2.090(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      170.000 to Point/Station      180.000
**** CONFLUENCE OF MAIN STREAMS ****
------------------------------------------------------------------------
The following data inside Main Stream is listed:
In Main Stream number: 3
Stream flow area =      2.090(Ac.)
Runoff from this stream =     9.450(CFS)
Time of concentration =    6.59 min.
Rainfall intensity =     5.514(In/Hr)
Summary of stream data:

Stream   Flow rate      TC            Rainfall Intensity
 No.       (CFS)       (min)                (In/Hr)


1       48.332      8.24           4.773
2       25.251      7.71           4.981
3        9.450      6.59           5.514
Qmax(1) =
            1.000 *    1.000 *    48.332) +
            0.958 *    1.000 *    25.251) +
            0.866 *    1.000 *     9.450) + =      80.708
Qmax(2) =
            1.000 *    0.936 *    48.332) +
            1.000 *    1.000 *    25.251) +
            0.903 *    1.000 *     9.450) + =      79.026
Qmax(3) =
            1.000 *    0.799 *    48.332) +
            1.000 *    0.854 *    25.251) +
            1.000 *    1.000 *     9.450) + =      69.652

Total of 3 main streams to confluence:
Flow rates before confluence point:
     48.332      25.251       9.450
Maximum flow rates at confluence using above data:
      80.708      79.026      69.652
Area of streams before confluence:
      11.510       6.290       2.090


Results of confluence:
Total flow rate =     80.708(CFS)
Time of concentration =     8.239 min.
Effective stream area after confluence  =     19.890(Ac.)
End of computations, total study area =          19.890 (Ac.)
```

San Diego County Rational Hydrology Program

CIVILCADD/CIVILDESIGN Engineering Software,(c)1991-2004 Version 7.4

Rational method hydrology program based on
San Diego County Flood Control Division 2003 hydrology manual
Rational Hydrology Study Date: 03/20/08

PDC JOB 3315 CALIFORNIA CROSSINGS
PROPOSED CONDITIONS
SYSTEM 200
FILE: S200P100

********* Hydrology Study Control Information **********

Program License Serial Number 4049

Rational hydrology study storm event year is 100.0
English (in-lb) input data Units used

Map data precipitation entered:
6 hour, precipitation(inches) = 2.500
24 hour precipitation(inches) = 5.500
P6/P24 = 45.5%
San Diego hydrology manual 'C' values used

++
Process from Point/Station 200.000 to Point/Station 205.000
**** INITIAL AREA EVALUATION ****

Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[UNDISTURBED NATURAL TERRAIN]
(Permanent Open Space)
Impervious value, Ai = 0.000
Sub-Area C Value = 0.350
Initial subarea total flow distance = 893.000(Ft.)
Highest elevation = 596.000(Ft.)
Lowest elevation = 560.000(Ft.)
Elevation difference = 36.000(Ft.) Slope = 4.031 %
INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
The maximum overland flow distance is 100.00 (Ft)
for the top area slope value of 4.03 %, in a development type of
Permanent Open Space
In Accordance With Figure 3-3
Initial Area Time of Concentration = 8.48 minutes
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.3500)*(100.000^.5)/(4.030^(1/3)]= 8.48
The initial area total distance of 893.00 (Ft.) entered leaves a
remaining distance of 793.00 (Ft.)
Using Figure 3-4, the travel time for this distance is 4.59 minutes
for a distance of 793.00 (Ft.) and a slope of 4.03 %
with an elevation difference of 31.96(Ft.) from the end of the top area
Tt = [11.9*length(Mi)^3)/(elevation change(Ft.))]^.385 *60(min/hr)
= 4.592 Minutes
Tt=[(11.9*0.1502^3)/(31.96)]^.385= 4.59
Total initial area Ti = 8.48 minutes from Figure 3-3 formula plus
4.59 minutes from the Figure 3-4 formula = 13.08 minutes
Rainfall intensity (I) = 3.543(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.350
Subarea runoff = 8.247(CFS)
Total initial stream area = 6.650(Ac.)

++
Process from Point/Station 205.000 to Point/Station 215.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****

Upstream point/station elevation = 556.000(Ft.)
Downstream point/station elevation = 546.000(Ft.)
Pipe length = 32.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 8.247(CFS)
Nearest computed pipe diameter = 9.00(In.)

```
Calculated individual pipe flow  =     8.247(CFS)
Normal flow depth in pipe =    6.62(In.)
Flow top width inside pipe =    7.94(In.)
Critical depth could not be calculated.
Pipe flow velocity =     23.66(Ft/s)
Travel time through pipe =    0.02 min.
Time of concentration (TC) =    13.10 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      205.000 to Point/Station      215.000
**** CONFLUENCE OF MINOR STREAMS ****
----------------------------------------------------------------------------
Along Main Stream number: 1 in normal stream number 1
Stream flow area =      6.650(Ac.)
Runoff from this stream =      8.247(CFS)
Time of concentration =   13.10 min.
Rainfall intensity =     3.539(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      207.000 to Point/Station      210.000
**** INITIAL AREA EVALUATION ****
----------------------------------------------------------------------------
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[COMMERCIAL area type                          ]
(General Commercial    )
Impervious value, Ai = 0.850
Sub-Area C Value = 0.820
Initial subarea total flow distance  =  184.000(Ft.)
Highest elevation =  551.500(Ft.)
Lowest elevation =  550.000(Ft.)
Elevation difference =    1.500(Ft.) Slope =  0.815 %
INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
The maximum overland flow distance is 60.00 (Ft)
for the top area slope value of   0.82 %, in a development type of
 General Commercial
In Accordance With Figure 3-3
Initial Area Time of Concentration =   4.17 minutes
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.8200)*(  60.000^.5)/(   0.820^(1/3)]=   4.17
The initial area total distance of  184.00 (Ft.) entered leaves a
remaining distance of  124.00 (Ft.)
Using Figure 3-4, the travel time for this distance is   2.03 minutes
for a distance of 124.00 (Ft.) and a slope of  0.82 %
with an elevation difference of   1.02(Ft.) from the end of the top area
Tt = [11.9*length(Mi)^3)/(elevation change(Ft.))]^.385 *60(min/hr)
 =    2.031 Minutes
Tt=[(11.9*0.0235^3)/(  1.02)]^.385=  2.03
Total initial area Ti =   4.17 minutes from Figure 3-3 formula plus
  2.03 minutes from the Figure 3-4 formula =   6.20 minutes
Rainfall intensity (I) =     5.732(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.820
Subarea runoff =      9.260(CFS)
Total initial stream area =       1.970(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      208.000 to Point/Station      210.000
**** SUBAREA FLOW ADDITION ****
----------------------------------------------------------------------------
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[INDUSTRIAL area type                          ]
(General Industrial       )
Impervious value, Ai = 0.950
Sub-Area C Value = 0.870
Time of concentration =     6.20 min.
Rainfall intensity =     5.732(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.835  CA =     2.355
Subarea runoff =      4.239(CFS) for      0.850(Ac.)
Total runoff =     13.499(CFS)    Total area =       2.820(Ac.)


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Process from Point/Station      210.000 to Point/Station      215.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
------------------------------------------------------------------------
Upstream point/station elevation =    547.000(Ft.)
Downstream point/station elevation =    546.000(Ft.)
Pipe length  =    251.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     13.499(CFS)
Nearest computed pipe diameter  =     24.00(In.)
Calculated individual pipe flow  =     13.499(CFS)
Normal flow depth in pipe =    18.59(In.)
Flow top width inside pipe =    20.06(In.)
Critical Depth =    15.88(In.)
Pipe flow velocity =       5.17(Ft/s)
Travel time through pipe =     0.81 min.
Time of concentration (TC) =      7.01 min.


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Process from Point/Station      210.000 to Point/Station      215.000
**** CONFLUENCE OF MINOR STREAMS ****
------------------------------------------------------------------------
Along Main Stream number: 1 in normal stream number 2
Stream flow area =       2.820(Ac.)
Runoff from this stream =      13.499(CFS)
Time of concentration =     7.01 min.
Rainfall intensity =      5.296(In/Hr)
Summary of stream data:

Stream    Flow rate       TC            Rainfall Intensity
 No.        (CFS)        (min)                 (In/Hr)


1         8.247      13.10            3.539
2        13.499       7.01            5.296
Qmax(1) =
             1.000 *     1.000 *      8.247) +
             0.668 *     1.000 *     13.499) + =       17.268
Qmax(2) =
             1.000 *     0.535 *      8.247) +
             1.000 *     1.000 *     13.499) + =       17.914

Total of 2 streams to confluence:
Flow rates before confluence point:
       8.247       13.499
Maximum flow rates at confluence using above data:
       17.268        17.914
Area of streams before confluence:
        6.650         2.820
Results of confluence:
Total flow rate =      17.914(CFS)
Time of concentration =      7.011 min.
Effective stream area after confluence =       9.470(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      215.000 to Point/Station      225.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
------------------------------------------------------------------------
Upstream point/station elevation =    546.000(Ft.)
Downstream point/station elevation =    544.300(Ft.)
Pipe length  =    292.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     17.914(CFS)
Nearest computed pipe diameter  =      27.00(In.)
Calculated individual pipe flow  =     17.914(CFS)
Normal flow depth in pipe =    17.58(In.)
Flow top width inside pipe =    25.74(In.)
Critical Depth =    17.74(In.)
Pipe flow velocity =       6.54(Ft/s)
Travel time through pipe =     0.74 min.
Time of concentration (TC) =      7.76 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      215.000 to Point/Station      225.000
**** CONFLUENCE OF MINOR STREAMS ****
------------------------------------------------------------------------
Along Main Stream number: 1 in normal stream number 1
Stream flow area =       9.470(Ac.)
Runoff from this stream =      17.914(CFS)
Time of concentration =     7.76 min.
Rainfall intensity =      4.963(In/Hr)
```

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++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      220.000 to Point/Station      225.000
**** INITIAL AREA EVALUATION ****
------------------------------------------------------------------------------
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[COMMERCIAL area type                    ]
(General Commercial     )
Impervious value, Ai = 0.850
Sub-Area C Value = 0.820
Initial subarea total flow distance  =  300.000(Ft.)
Highest elevation =  551.400(Ft.)
Lowest elevation =  549.800(Ft.)
Elevation difference =    1.600(Ft.) Slope =  0.533 %
INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
The maximum overland flow distance is 50.00 (Ft)
for the top area slope value of   0.53 %, in a development type of
 General Commercial
In Accordance With Figure 3-3
Initial Area Time of Concentration =   4.40 minutes
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.8200)*(  50.000^.5)/(   0.530^(1/3)]=   4.40
The initial area total distance of  300.00 (Ft.) entered leaves a
remaining distance of  250.00 (Ft.)
Using Figure 3-4, the travel time for this distance is   4.12 minutes
for a distance of 250.00 (Ft.) and a slope of  0.53 %
with an elevation difference of   1.33(Ft.) from the end of the top area
Tt = [11.9*length(Mi)^3)/(elevation change(Ft.))]^.385 *60(min/hr)
 =    4.123 Minutes
Tt=[(11.9*0.0473^3)/(  1.33)]^.385=  4.12
Total initial area Ti =   4.40 minutes from Figure 3-3 formula plus
 4.12 minutes from the Figure 3-4 formula =   8.53 minutes
Rainfall intensity (I) =      4.668(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.820
Subarea runoff =      3.024(CFS)
Total initial stream area =        0.790(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      222.000 to Point/Station      225.000
**** SUBAREA FLOW ADDITION ****
------------------------------------------------------------------------------
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[INDUSTRIAL area type                    ]
(General Industrial      )
Impervious value, Ai = 0.950
Sub-Area C Value = 0.870
Time of concentration =     8.53 min.
Rainfall intensity =      4.668(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.851  CA =      1.788
Subarea runoff =      5.321(CFS) for      1.310(Ac.)
Total runoff =      8.345(CFS)    Total area =       2.100(Ac.)


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Process from Point/Station      225.000 to Point/Station      225.000
**** CONFLUENCE OF MINOR STREAMS ****
------------------------------------------------------------------------------
Along Main Stream number: 1 in normal stream number 2
Stream flow area =      2.100(Ac.)
Runoff from this stream =      8.345(CFS)
Time of concentration =    8.53 min.
Rainfall intensity =     4.668(In/Hr)
Summary of stream data:

Stream   Flow rate      TC          Rainfall Intensity
 No.       (CFS)       (min)                (In/Hr)


1       17.914      7.76           4.963
2        8.345      8.53           4.668
Qmax(1) =
           1.000 *    1.000 *    17.914) +
```

```
          1.000 *    0.910 *     8.345) + =      25.504
Qmax(2) =
          0.941 *    1.000 *    17.914) +
          1.000 *    1.000 *     8.345) + =      25.197

Total of 2 streams to confluence:
Flow rates before confluence point:
     17.914       8.345
Maximum flow rates at confluence using above data:
      25.504       25.197
Area of streams before confluence:
       9.470        2.100
Results of confluence:
Total flow rate =     25.504(CFS)
Time of concentration =     7.756 min.
Effective stream area after confluence =     11.570(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      225.000 to Point/Station      230.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
----------------------------------------------------------------------
Upstream point/station elevation =   544.300(Ft.)
Downstream point/station elevation =   541.500(Ft.)
Pipe length  =   434.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =    25.504(CFS)
Nearest computed pipe diameter  =     30.00(In.)
Calculated individual pipe flow  =    25.504(CFS)
Normal flow depth in pipe =   19.83(In.)
Flow top width inside pipe =   28.40(In.)
Critical Depth =   20.65(In.)
Pipe flow velocity =      7.41(Ft/s)
Travel time through pipe =    0.98 min.
Time of concentration (TC) =     8.73 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      230.000 to Point/Station      230.000
**** SUBAREA FLOW ADDITION ****
----------------------------------------------------------------------
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[COMMERCIAL area type                        ]
(General Commercial    )
Impervious value, Ai = 0.850
Sub-Area C Value = 0.820
Time of concentration =     8.73 min.
Rainfall intensity =      4.597(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.588  CA =      7.642
Subarea runoff =      9.631(CFS) for      1.430(Ac.)
Total runoff =     35.135(CFS)    Total area =      13.000(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      230.000 to Point/Station      235.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
----------------------------------------------------------------------
Upstream point/station elevation =   541.500(Ft.)
Downstream point/station elevation =   541.000(Ft.)
Pipe length  =    37.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =    35.135(CFS)
Nearest computed pipe diameter  =     27.00(In.)
Calculated individual pipe flow  =    35.135(CFS)
Normal flow depth in pipe =   21.56(In.)
Flow top width inside pipe =   21.66(In.)
Critical Depth =   24.15(In.)
Pipe flow velocity =     10.32(Ft/s)
Travel time through pipe =    0.06 min.
Time of concentration (TC) =     8.79 min.


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Process from Point/Station      235.000 to Point/Station      238.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
----------------------------------------------------------------------
Upstream point/station elevation =   541.000(Ft.)
Downstream point/station elevation =   540.000(Ft.)
Pipe length  =   392.00(Ft.)   Manning's N = 0.013
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```
No. of pipes = 1  Required pipe flow  =    35.135(CFS)
Nearest computed pipe diameter  =    39.00(In.)
Calculated individual pipe flow  =    35.135(CFS)
Normal flow depth in pipe =   27.42(In.)
Flow top width inside pipe =   35.64(In.)
Critical Depth =   22.58(In.)
Pipe flow velocity =      5.63(Ft/s)
Travel time through pipe =    1.16 min.
Time of concentration (TC) =     9.95 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      235.000 to Point/Station      238.000
**** CONFLUENCE OF MINOR STREAMS ****
------------------------------------------------------------------------------
Along Main Stream number: 1 in normal stream number 1
Stream flow area =     13.000(Ac.)
Runoff from this stream =     35.135(CFS)
Time of concentration =    9.95 min.
Rainfall intensity =     4.226(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      236.000 to Point/Station      238.000
**** INITIAL AREA EVALUATION ****
------------------------------------------------------------------------------
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[INDUSTRIAL area type                        ]
(General Industrial       )
Impervious value, Ai = 0.950
Sub-Area C Value = 0.870
Initial subarea total flow distance  =  620.000(Ft.)
Highest elevation =  576.000(Ft.)
Lowest elevation =  546.000(Ft.)
Elevation difference =   30.000(Ft.) Slope =  4.839 %
INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
The maximum overland flow distance is 90.00 (Ft)
for the top area slope value of   4.84 %, in a development type of
 General Industrial
In Accordance With Figure 3-3
Initial Area Time of Concentration =   2.32 minutes
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.8700)*(  90.000^.5)/(   4.840^(1/3)]=   2.32
The initial area total distance of  620.00 (Ft.) entered leaves a
remaining distance of  530.00 (Ft.)
Using Figure 3-4, the travel time for this distance is   3.14 minutes
for a distance of 530.00 (Ft.) and a slope of  4.84 %
with an elevation difference of  25.65(Ft.) from the end of the top area
Tt = [11.9*length(Mi)^3)/(elevation change(Ft.))]^.385 *60(min/hr)
 =    3.138 Minutes
Tt=[(11.9*0.1004^3)/( 25.65)]^.385=  3.14
Total initial area Ti =   2.32 minutes from Figure 3-3 formula plus
  3.14 minutes from the Figure 3-4 formula =   5.46 minutes
Rainfall intensity (I) =      6.224(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.870
Subarea runoff =      3.736(CFS)
Total initial stream area =        0.690(Ac.)


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Process from Point/Station      237.000 to Point/Station      238.000
**** SUBAREA FLOW ADDITION ****
------------------------------------------------------------------------------
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[INDUSTRIAL area type                        ]
(General Industrial       )
Impervious value, Ai = 0.950
Sub-Area C Value = 0.870
Time of concentration =     5.46 min.
Rainfall intensity =      6.224(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.870  CA =      1.175
Subarea runoff =      3.574(CFS) for      0.660(Ac.)
Total runoff =      7.310(CFS)    Total area =       1.350(Ac.)
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Process from Point/Station      237.000 to Point/Station      238.000
**** CONFLUENCE OF MINOR STREAMS ****
----------------------------------------------------------------------------
Along Main Stream number: 1 in normal stream number 2
Stream flow area =      1.350(Ac.)
Runoff from this stream =      7.310(CFS)
Time of concentration =    5.46 min.
Rainfall intensity =     6.224(In/Hr)
Summary of stream data:

Stream    Flow rate      TC            Rainfall Intensity
 No.        (CFS)       (min)                 (In/Hr)


1        35.135       9.95           4.226
2         7.310       5.46           6.224
Qmax(1) =
            1.000 *    1.000 *    35.135) +
            0.679 *    1.000 *     7.310) + =      40.098
Qmax(2) =
            1.000 *    0.549 *    35.135) +
            1.000 *    1.000 *     7.310) + =      26.587

Total of 2 streams to confluence:
Flow rates before confluence point:
      35.135       7.310
Maximum flow rates at confluence using above data:
       40.098       26.587
Area of streams before confluence:
       13.000        1.350
Results of confluence:
Total flow rate =     40.098(CFS)
Time of concentration =     9.951 min.
Effective stream area after confluence =     14.350(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      238.000 to Point/Station      265.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
----------------------------------------------------------------------------
Upstream point/station elevation =   540.000(Ft.)
Downstream point/station elevation =   539.500(Ft.)
Pipe length  =    91.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =    40.098(CFS)
Nearest computed pipe diameter  =     36.00(In.)
Calculated individual pipe flow  =    40.098(CFS)
Normal flow depth in pipe =   24.61(In.)
Flow top width inside pipe =   33.49(In.)
Critical Depth =   24.72(In.)
Pipe flow velocity =      7.79(Ft/s)
Travel time through pipe =    0.19 min.
Time of concentration (TC) =    10.15 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      238.000 to Point/Station      265.000
**** CONFLUENCE OF MINOR STREAMS ****
----------------------------------------------------------------------------
Along Main Stream number: 1 in normal stream number 1
Stream flow area =     14.350(Ac.)
Runoff from this stream =     40.098(CFS)
Time of concentration =   10.15 min.
Rainfall intensity =     4.173(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      250.000 to Point/Station      255.000
**** INITIAL AREA EVALUATION ****
----------------------------------------------------------------------------
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[COMMERCIAL area type                    ]
(General Commercial    )
Impervious value, Ai = 0.850
Sub-Area C Value = 0.820
Initial subarea total flow distance  =  373.000(Ft.)
Highest elevation =  551.000(Ft.)
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Lowest elevation =  545.000(Ft.)
Elevation difference =    6.000(Ft.) Slope =  1.609 %
INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
The maximum overland flow distance is 75.00 (Ft)
for the top area slope value of   1.61 %, in a development type of
 General Commercial
In Accordance With Figure 3-3
Initial Area Time of Concentration =   3.72 minutes
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.8200)*(  75.000^.5)/(   1.610^(1/3)]=   3.72
The initial area total distance of  373.00 (Ft.) entered leaves a
remaining distance of  298.00 (Ft.)
Using Figure 3-4, the travel time for this distance is   3.08 minutes
for a distance of 298.00 (Ft.) and a slope of  1.61 %
with an elevation difference of   4.80(Ft.) from the end of the top area
Tt = [11.9*length(Mi)^3)/(elevation change(Ft.))]^.385 *60(min/hr)
 =    3.077 Minutes
Tt=[(11.9*0.0564^3)/(  4.80)]^.385=  3.08
Total initial area Ti =   3.72 minutes from Figure 3-3 formula plus
  3.08 minutes from the Figure 3-4 formula =   6.80 minutes
Rainfall intensity (I) =      5.401(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.820
Subarea runoff =     12.756(CFS)
Total initial stream area =        2.880(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      255.000 to Point/Station      260.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
------------------------------------------------------------------------
Upstream point/station elevation =   539.000(Ft.)
Downstream point/station elevation =   538.000(Ft.)
Pipe length  =   187.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =    12.756(CFS)
Nearest computed pipe diameter  =     24.00(In.)
Calculated individual pipe flow  =    12.756(CFS)
Normal flow depth in pipe =   15.82(In.)
Flow top width inside pipe =   22.75(In.)
Critical Depth =   15.41(In.)
Pipe flow velocity =      5.81(Ft/s)
Travel time through pipe =    0.54 min.
Time of concentration (TC) =     7.34 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      260.000 to Point/Station      260.000
**** SUBAREA FLOW ADDITION ****
------------------------------------------------------------------------
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[COMMERCIAL area type                        ]
(General Commercial    )
Impervious value, Ai = 0.850
Sub-Area C Value = 0.820
Time of concentration =     7.34 min.
Rainfall intensity =      5.143(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.820  CA =      2.665
Subarea runoff =      0.951(CFS) for      0.370(Ac.)
Total runoff =     13.707(CFS)    Total area =       3.250(Ac.)


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Process from Point/Station      260.000 to Point/Station      265.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
------------------------------------------------------------------------
Upstream point/station elevation =   538.000(Ft.)
Downstream point/station elevation =   536.000(Ft.)
Pipe length  =   150.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =    13.707(CFS)
Nearest computed pipe diameter  =     21.00(In.)
Calculated individual pipe flow  =    13.707(CFS)
Normal flow depth in pipe =   13.56(In.)
Flow top width inside pipe =   20.09(In.)
Critical Depth =   16.52(In.)
Pipe flow velocity =      8.35(Ft/s)
Travel time through pipe =    0.30 min.
Time of concentration (TC) =     7.64 min.
```

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Process from Point/Station      260.000 to Point/Station      265.000
**** CONFLUENCE OF MINOR STREAMS ****
----------------------------------------------------------------------------
Along Main Stream number: 1 in normal stream number 2
Stream flow area =      3.250(Ac.)
Runoff from this stream =      13.707(CFS)
Time of concentration =     7.64 min.
Rainfall intensity =      5.012(In/Hr)
Summary of stream data:

Stream    Flow rate       TC            Rainfall Intensity
 No.       (CFS)        (min)                 (In/Hr)


1        40.098      10.15            4.173
2        13.707       7.64            5.012
Qmax(1) =
            1.000 *     1.000 *     40.098) +
            0.833 *     1.000 *     13.707) + =       51.511
Qmax(2) =
            1.000 *     0.753 *     40.098) +
            1.000 *     1.000 *     13.707) + =       43.890

Total of 2 streams to confluence:
Flow rates before confluence point:
      40.098       13.707
Maximum flow rates at confluence using above data:
       51.511       43.890
Area of streams before confluence:
       14.350        3.250
Results of confluence:
Total flow rate =      51.511(CFS)
Time of concentration =     10.146 min.
Effective stream area after confluence =      17.600(Ac.)

++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      265.000 to Point/Station      285.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
----------------------------------------------------------------------------
Upstream point/station elevation =    536.000(Ft.)
Downstream point/station elevation =    532.000(Ft.)
Pipe length  =    480.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     51.511(CFS)
Nearest computed pipe diameter  =     36.00(In.)
Calculated individual pipe flow  =     51.511(CFS)
Normal flow depth in pipe =    25.41(In.)
Flow top width inside pipe =    32.81(In.)
Critical Depth =    28.01(In.)
Pipe flow velocity =       9.66(Ft/s)
Travel time through pipe =     0.83 min.
Time of concentration (TC) =     10.97 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      265.000 to Point/Station      285.000
**** CONFLUENCE OF MINOR STREAMS ****
----------------------------------------------------------------------------
Along Main Stream number: 1 in normal stream number 1
Stream flow area =      17.600(Ac.)
Runoff from this stream =      51.511(CFS)
Time of concentration =    10.97 min.
Rainfall intensity =      3.967(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      275.000 to Point/Station      280.000
**** INITIAL AREA EVALUATION ****
----------------------------------------------------------------------------
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[UNDISTURBED NATURAL TERRAIN                ]
(Permanent Open Space    )
Impervious value, Ai = 0.000
Sub-Area C Value = 0.350
Initial subarea total flow distance  =  788.000(Ft.)
Highest elevation =  616.000(Ft.)
```

```
Lowest elevation = 572.000(Ft.)
Elevation difference =  44.000(Ft.) Slope =  5.584 %
INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
The maximum overland flow distance is 100.00 (Ft)
for the top area slope value of  5.58 %, in a development type of
 Permanent Open Space
In Accordance With Figure 3-3
Initial Area Time of Concentration =  7.61 minutes
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.3500)*( 100.000^.5)/(  5.584^(1/3)]=  7.61
The initial area total distance of  788.00 (Ft.) entered leaves a
remaining distance of  688.00 (Ft.)
Using Figure 3-4, the travel time for this distance is  3.63 minutes
for a distance of 688.00 (Ft.) and a slope of  5.58 %
with an elevation difference of  38.42(Ft.) from the end of the top area
Tt = [11.9*length(Mi)^3)/(elevation change(Ft.))]^.385 *60(min/hr)
 =  3.630 Minutes
Tt=[(11.9*0.1303^3)/( 38.42)]^.385=  3.63
Total initial area Ti =  7.61 minutes from Figure 3-3 formula plus
  3.63 minutes from the Figure 3-4 formula =  11.24 minutes
Rainfall intensity (I) =  3.906(In/Hr) for a  100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.350
Subarea runoff =  11.321(CFS)
Total initial stream area =  8.280(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station  280.000 to Point/Station  285.000
**** IMPROVED CHANNEL TRAVEL TIME ****
------------------------------------------------------------------------
Upstream point elevation =  572.000(Ft.)
Downstream point elevation =  541.000(Ft.)
Channel length thru subarea =  1219.000(Ft.)
Channel base width  =  20.000(Ft.)
Slope or 'Z' of left channel bank =  5.000
Slope or 'Z' of right channel bank =  5.000
Estimated mean flow rate at midpoint of channel =  16.748(CFS)
Manning's 'N'  = 0.030
Maximum depth of channel =  1.000(Ft.)
Flow(q) thru subarea =  16.748(CFS)
Depth of flow =  0.257(Ft.), Average velocity =  3.064(Ft/s)
Channel flow top width =  22.568(Ft.)
Flow Velocity =  3.06(Ft/s)
Travel time  =  6.63 min.
Time of concentration =  17.87 min.
Critical depth =  0.273(Ft.)
 Adding area flow to channel
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[UNDISTURBED NATURAL TERRAIN  ]
(Permanent Open Space  )
Impervious value, Ai = 0.000
Sub-Area C Value = 0.350
Rainfall intensity =  2.897(In/Hr) for a  100.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.350  CA =  7.626
Subarea runoff =  10.771(CFS) for  13.510(Ac.)
Total runoff =  22.091(CFS)  Total area =  21.790(Ac.)
Depth of flow =  0.302(Ft.), Average velocity =  3.396(Ft/s)
Critical depth =  0.328(Ft.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station  280.000 to Point/Station  285.000
**** CONFLUENCE OF MINOR STREAMS ****
------------------------------------------------------------------------
Along Main Stream number: 1 in normal stream number 2
Stream flow area =  21.790(Ac.)
Runoff from this stream =  22.091(CFS)
Time of concentration =  17.87 min.
Rainfall intensity =  2.897(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station  281.000 to Point/Station  285.000
**** INITIAL AREA EVALUATION ****
------------------------------------------------------------------------
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
```

```
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[INDUSTRIAL area type                    ]
(General Industrial       )
Impervious value, Ai = 0.950
Sub-Area C Value = 0.870
Initial subarea total flow distance  =  555.000(Ft.)
Highest elevation =  545.000(Ft.)
Lowest elevation =  538.000(Ft.)
Elevation difference =    7.000(Ft.) Slope =  1.261 %
INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
The maximum overland flow distance is 60.00 (Ft)
for the top area slope value of   1.26 %, in a development type of
 General Industrial
In Accordance With Figure 3-3
Initial Area Time of Concentration =   2.97 minutes
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.8700)*(  60.000^.5)/(   1.260^(1/3)]=   2.97
The initial area total distance of  555.00 (Ft.) entered leaves a
remaining distance of  495.00 (Ft.)
Using Figure 3-4, the travel time for this distance is   5.00 minutes
for a distance of 495.00 (Ft.) and a slope of  1.26 %
with an elevation difference of   6.24(Ft.) from the end of the top area
Tt = [11.9*length(Mi)^3)/(elevation change(Ft.))]^.385 *60(min/hr)
 =    4.998 Minutes
Tt=[(11.9*0.0938^3)/(  6.24)]^.385=  5.00
Total initial area Ti =   2.97 minutes from Figure 3-3 formula plus
  5.00 minutes from the Figure 3-4 formula =   7.97 minutes
Rainfall intensity (I) =      4.877(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.870
Subarea runoff =      2.503(CFS)
Total initial stream area =        0.590(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      282.000 to Point/Station      285.000
**** SUBAREA FLOW ADDITION ****
----------------------------------------------------------------------
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[INDUSTRIAL area type                    ]
(General Industrial       )
Impervious value, Ai = 0.950
Sub-Area C Value = 0.870
Time of concentration =     7.97 min.
Rainfall intensity =      4.877(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.870  CA =      1.114
Subarea runoff =      2.928(CFS) for      0.690(Ac.)
Total runoff =      5.431(CFS)     Total area =       1.280(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      282.000 to Point/Station      285.000
**** CONFLUENCE OF MINOR STREAMS ****
----------------------------------------------------------------------
Along Main Stream number: 1 in normal stream number 3
Stream flow area =      1.280(Ac.)
Runoff from this stream =      5.431(CFS)
Time of concentration =    7.97 min.
Rainfall intensity =     4.877(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      270.000 to Point/Station      270.000
**** INITIAL AREA EVALUATION ****
----------------------------------------------------------------------
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[INDUSTRIAL area type                    ]
(General Industrial       )
Impervious value, Ai = 0.950
Sub-Area C Value = 0.870
Initial subarea total flow distance  =  100.000(Ft.)
Highest elevation =  537.000(Ft.)
Lowest elevation =  535.000(Ft.)
Elevation difference =    2.000(Ft.) Slope =  2.000 %
```

```
USER ENTRY OF INITIAL AREA TIME OF CONCENTRATION
Time of Concentration =   5.00 minutes
Rainfall intensity (I) =      6.587(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.870
Subarea runoff =      0.802(CFS)
Total initial stream area =        0.140(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      270.000 to Point/Station      285.000
**** CONFLUENCE OF MINOR STREAMS ****
----------------------------------------------------------------------------
Along Main Stream number: 1 in normal stream number 4
Stream flow area =      0.140(Ac.)
Runoff from this stream =      0.802(CFS)
Time of concentration =   5.00 min.
Rainfall intensity =     6.587(In/Hr)
Summary of stream data:

Stream   Flow rate      TC            Rainfall Intensity
 No.       (CFS)       (min)                 (In/Hr)


1       51.511     10.97           3.967
2       22.091     17.87           2.897
3        5.431      7.97           4.877
4        0.802      5.00           6.587
Qmax(1) =
            1.000 *    1.000 *    51.511) +
            1.000 *    0.614 *    22.091) +
            0.813 *    1.000 *     5.431) +
            0.602 *    1.000 *     0.802) + =      69.978
Qmax(2) =
            0.730 *    1.000 *    51.511) +
            1.000 *    1.000 *    22.091) +
            0.594 *    1.000 *     5.431) +
            0.440 *    1.000 *     0.802) + =      63.280
Qmax(3) =
            1.000 *    0.726 *    51.511) +
            1.000 *    0.446 *    22.091) +
            1.000 *    1.000 *     5.431) +
            0.740 *    1.000 *     0.802) + =      53.273
Qmax(4) =
            1.000 *    0.456 *    51.511) +
            1.000 *    0.280 *    22.091) +
            1.000 *    0.628 *     5.431) +
            1.000 *    1.000 *     0.802) + =      33.863

Total of 4 streams to confluence:
Flow rates before confluence point:
      51.511      22.091       5.431       0.802
Maximum flow rates at confluence using above data:
       69.978       63.280       53.273       33.863
Area of streams before confluence:
       17.600       21.790        1.280        0.140
Results of confluence:
Total flow rate =     69.978(CFS)
Time of concentration =    10.973 min.
Effective stream area after confluence =     40.810(Ac.)
End of computations, total study area =          40.810 (Ac.)
```

APPENDIX 4

Preliminary Detention Calculations

RATIONAL METHOD HYDROGRAPH PROGRAM

RUN DATE 3/20/2008
HYDROGRAPH FILE NAME S100P100.TXT
TIME OF CONCENTRATION 8 MIN.
6 HOUR RAINFALL 2.5 INCHES
BASIN AREA 19.89 ACRES
RUNOFF COEFFICIENT 0.859
PEAK DISCHARGE 80.708 CFS

TIME (MIN) =	0	DISCHARGE (CFS) =	0
TIME (MIN) =	8	DISCHARGE (CFS) =	2.6
TIME (MIN) =	16	DISCHARGE (CFS) =	2.6
TIME (MIN) =	24	DISCHARGE (CFS) =	2.7
TIME (MIN) =	32	DISCHARGE (CFS) =	2.7
TIME (MIN) =	40	DISCHARGE (CFS) =	2.8
TIME (MIN) =	48	DISCHARGE (CFS) =	2.8
TIME (MIN) =	56	DISCHARGE (CFS) =	3
TIME (MIN) =	64	DISCHARGE (CFS) =	3
TIME (MIN) =	72	DISCHARGE (CFS) =	3.1
TIME (MIN) =	80	DISCHARGE (CFS) =	3.2
TIME (MIN) =	88	DISCHARGE (CFS) =	3.3
TIME (MIN) =	96	DISCHARGE (CFS) =	3.4
TIME (MIN) =	104	DISCHARGE (CFS) =	3.6
TIME (MIN) =	112	DISCHARGE (CFS) =	3.7
TIME (MIN) =	120	DISCHARGE (CFS) =	3.9
TIME (MIN) =	128	DISCHARGE (CFS) =	4
TIME (MIN) =	136	DISCHARGE (CFS) =	4.2
TIME (MIN) =	144	DISCHARGE (CFS) =	4.3
TIME (MIN) =	152	DISCHARGE (CFS) =	4.7
TIME (MIN) =	160	DISCHARGE (CFS) =	4.8
TIME (MIN) =	168	DISCHARGE (CFS) =	5.3
TIME (MIN) =	176	DISCHARGE (CFS) =	5.5
TIME (MIN) =	184	DISCHARGE (CFS) =	6.1
TIME (MIN) =	192	DISCHARGE (CFS) =	6.5
TIME (MIN) =	200	DISCHARGE (CFS) =	7.4
TIME (MIN) =	208	DISCHARGE (CFS) =	8.1
TIME (MIN) =	216	DISCHARGE (CFS) =	9.8
TIME (MIN) =	224	DISCHARGE (CFS) =	11.2
TIME (MIN) =	232	DISCHARGE (CFS) =	16.5
TIME (MIN) =	240	DISCHARGE (CFS) =	25.6
TIME (MIN) =	248	DISCHARGE (CFS) =	80.708
TIME (MIN) =	256	DISCHARGE (CFS) =	13.2
TIME (MIN) =	264	DISCHARGE (CFS) =	8.8
TIME (MIN) =	272	DISCHARGE (CFS) =	6.9
TIME (MIN) =	280	DISCHARGE (CFS) =	5.8
TIME (MIN) =	288	DISCHARGE (CFS) =	5
TIME (MIN) =	296	DISCHARGE (CFS) =	4.5
TIME (MIN) =	304	DISCHARGE (CFS) =	4.1
TIME (MIN) =	312	DISCHARGE (CFS) =	3.7
TIME (MIN) =	320	DISCHARGE (CFS) =	3.5
TIME (MIN) =	328	DISCHARGE (CFS) =	3.3
TIME (MIN) =	336	DISCHARGE (CFS) =	3.1
TIME (MIN) =	344	DISCHARGE (CFS) =	2.9
TIME (MIN) =	352	DISCHARGE (CFS) =	2.8
TIME (MIN) =	360	DISCHARGE (CFS) =	2.6
TIME (MIN) =	368	DISCHARGE (CFS) =	0

SYSTEM 100 - COMPOSITE RUNOFF COEFFICIENT CALCULATIONS

C	A	C*A
0.87	2.78	2.419
0.87	2.62	2.279
0.87	0.81	0.705
0.87	0.85	0.740
0.87	2.53	2.201
0.82	1	0.820
0.87	0.92	0.800
0.87	1.56	1.357
0.82	1.37	1.123
0.87	0.19	0.165
0.87	1.39	1.209
0.87	1.78	1.549
0.82	2.09	1.714
11.16	19.89	17.081

C= **0.8588**

File.... P:\3315\ENGR\REPORTS\DRAIN\DETENTION\PRELIM-VOL.PPW

DETENTION VOLUME REQUIRED

≈ 1.0 AF

DETENTION STORAGE ESTIMATES -- Target Peak Outflow Rate

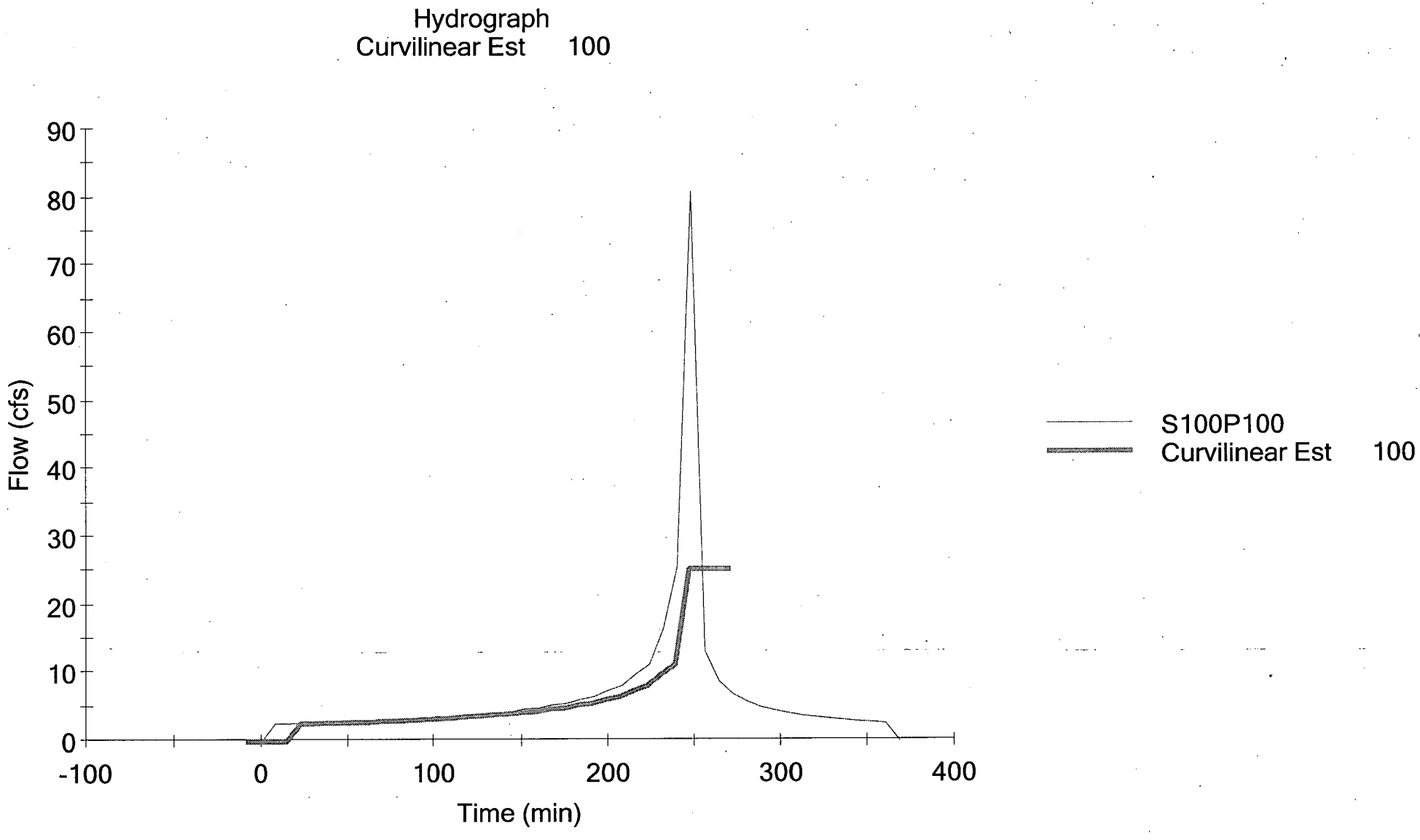
Return Events	Peak In (cfs)	Target (cfs)	Lower (ac-ft)	Linear (ac-ft)	Curvlinr (ac-ft)	Upper (ac-ft)	Total (ac-ft)
100	80.708	25.320	.557	.681	.978	2.802	3.541

CALCULATION TIME RANGES

Return Events	Lower From (min)	Lower To (min)	Linear From (min)	Linear To (min)	Curvilinear From (min)	Curvilinear To (min)	Upper From (min)	Upper To (min)	Total From (min)	Total To (min)
100	4.00	254.56	3.73	254.56	.00	254.56	.00	254.56	.00	368.00

SYSTEM 100

Qallowable out of detention basin
= 95.3 − 69.98 = "BACKBONE" − "System 200"
= 25.32 cfs

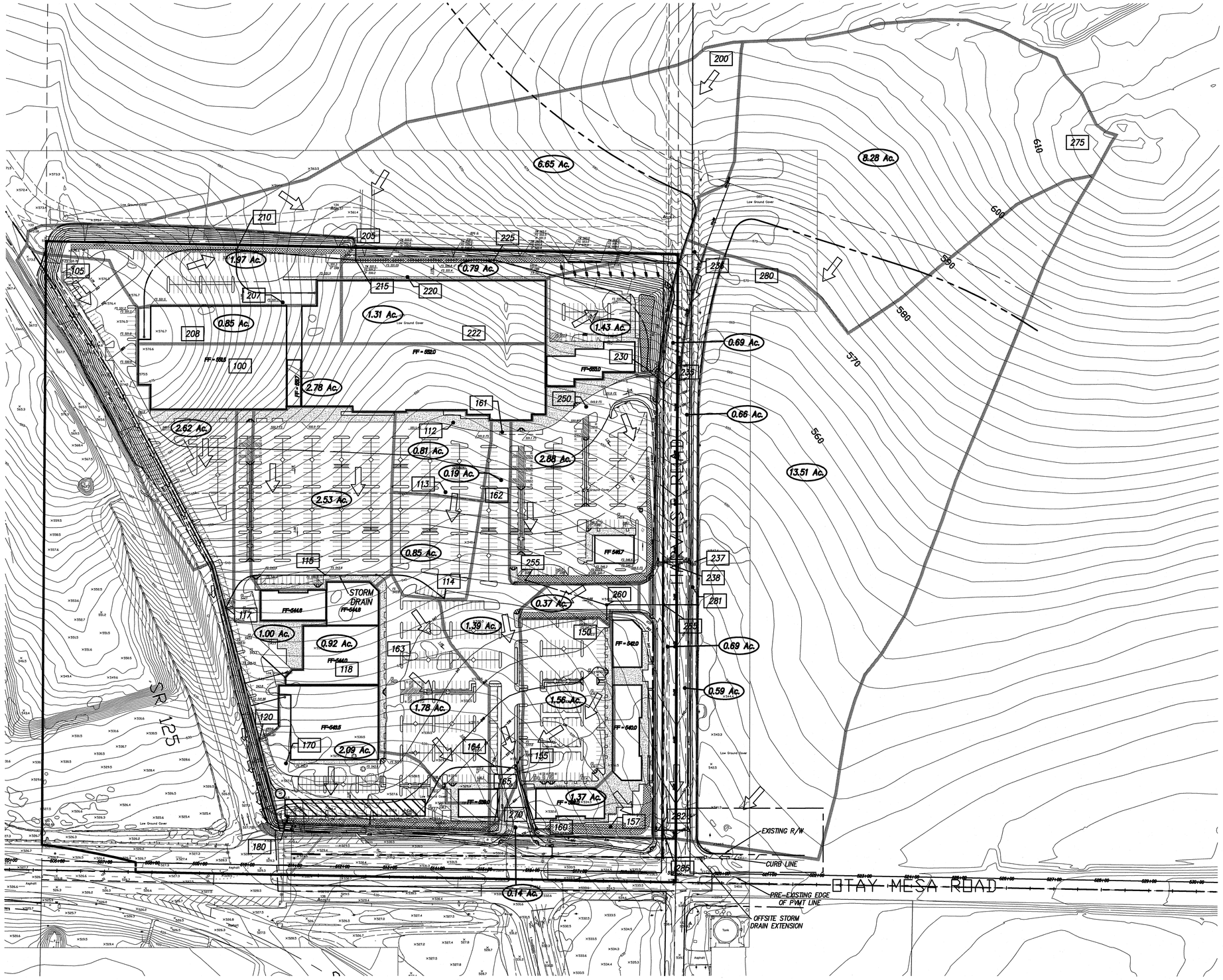

Hydrograph
Curvilinear Est 100
90
80
70
60
50
40
30
20
10
0
Flow (cfs)
-100
0
100
200
300
400
Time (min)
S100P100
Curvilinear Est 100

APPENDIX 5

Drainage Exhibits

EXHIBIT A

Drainage Map – Developed Conditions



LEGEND

- DRAINAGE SUBAREA
- AREA FROM UPSTREAM TO DOWNSTREAM NODE (X.XX Ac.)
- FLOW DIRECTION
- HYDROLOGY NODE (#)
- BIOSWALE
- UNDERGROUND DETENTION (~1.2 ACFT)

N

0 50 100 200 300

GRAPHICAL SCALE

SCALE:	1"=100'
JOB #:	3315.00
CREATED:	3/21/07

PREPARED BY:

PROJECT DESIGN CONSULTANTS
Planning | Landscape Architecture | Environmental | Engineering | Survey
701 B Street, Suite 800 San Diego, CA 92101
619.235.6471 Tel 619.234.0349 Fax

COUNTY OF SAN DIEGO
CALIFORNIA CROSSINGS

HYDROLOGY MAP
DEVELOPED CONDITIONS
EXHIBIT A

LAST SAVED BY: Chelsa Pack, FILE NAME: P:\3315\ENGR\REPORTS\DRAIN\EXH\(B)Proposed Conditions2008.dwg, DATE SAVED LAST: 7/2/2009 3:48:17 PM, PLOTTED LAST: 7/2/2009 4:57:18 PM